



FINAL REPORT

REMEDIAL INVESTIGATION

SCP SITE

CARLSTADT, NEW JERSEY

VOLUME I

(TEXT, TABLES AND FIGURES)

JOB NO. 14485-002-010



Dames & Moore



DAMES & MOORE

A PROFESSIONAL LIMITED PARTNERSHIP

12 COMMERCE DRIVE, CRANFORD, NEW JERSEY 07016-1101 (201) 272-6300

March 1, 1990

Langan Environmental Services, Inc.
River Drive Center 2
Elmwood Park, New Jersey 07407

Attention: Dr. Donald Murphy, P.E., SCP-Carlstadt Facility Coordinator

Re: Final Report
Remedial Investigation
Volumes I and II
SCP Site
Carlstadt, New Jersey

Dear Dr. Murphy:

Dames & Moore is pleased to submit 20 copies of Volumes I and II of the Final Report for our Remedial Investigation of the SCP site in Carlstadt, New Jersey. We understand that a total of 131 copies of the Final Remedial Investigation Report are required. The remaining 111 copies will be presented to you by March 7, 1990.

Dames & Moore has incorporated into the Remedial Investigation Final Report specific changes to our initial Remedial Investigation Report dated September 19, 1989, as requested by the USEPA in its letter dated February 8, 1990. These changes and the USEPA's comments were further amended and/or clarified during a telephone conversation between Ms. Janet Feldstein of the USEPA and Mr. Gerard Coscia, P.E., of Langan Environmental Services, Inc. on February 15, 1990.

On February 22, 1990, Dames & Moore submitted for final review 50 draft copies of this final report that incorporated the USEPA's comments. Mr. Coscia presented comments on that draft report to Dames & Moore on February 27, 1990. This Final Remedial Investigation Report also includes those final comments as discussed with Mr. Coscia.

Also, as requested by the USEPA, Dames & Moore is obtaining copies of the aerial photographs reviewed as part of the Remedial Investigation and discussed in the report. Three sets of these photographs will be submitted to you after they are received.

Please contact us if you have any questions.

Very truly yours,

DAMES & MOORE

Louis J. Apaldo, P.E.
Project Manager

LJA/jhm
Enclosures

EXECUTIVE SUMMARY

The Scientific Chemical Processing (SCP) site in Carlstadt, New Jersey, is a former waste processing facility which, prior to its shutdown in October 1980, accepted wastes for recovery, disposal or further disposition. Aerial photographs indicate storage of drummed materials on the site from as early as 1951 until 1978. At the time of the facility shutdown, over 300,000 gallons of waste or recyclable materials were stored at the site. These materials have since been removed. The 5.9-acre site is now vacant, except for two small buildings, several concrete slabs, and piles of construction rubble from demolition of other site structures. A roll-off container holding a steel tank containing highly contaminated PCB sludge remains from the surface cleanup. The site is fenced on three sides and is bounded by Peach Island Creek on the fourth.

This remedial investigation was undertaken to evaluate the ground water and soil conditions beneath the site, and in the adjacent creek. The data were collected to evaluate risks that the site may pose to public health and the environment, and to provide a basis for the evaluation of necessary remedial measures. Samples were collected from unsaturated fill, saturated fill, clay, ground water and the surface water and sediments in Peach Island Creek, and chemical analyses were performed on these samples. Additional data to characterize the site hydrogeology were also obtained.

Site stratigraphy consists of earthen fill material underlain by a naturally-occurring clay, underlain by glacial till which overlies bedrock comprised of shale.

The analytical results indicate that organic and inorganic chemical contaminants are present within all of the environmental media

sampled. The primary impact zone is in the unsaturated and saturated soils which extends to an average depth of approximately 10 feet across the site.

A wide variety of contaminants are present at the site, including volatile organic compounds, base/neutral compounds, acid extractable compounds, polychlorinated biphenyls (PCBs), heavy metals, petroleum hydrocarbons and pesticides. Many of these compounds are present at high levels in all media sampled at the site.

Within the unsaturated portion of the fill (0 to 2 feet below grade), total volatile organic concentrations ranged from 0.024 mg/kg to 12,167 mg/kg (parts per million or "ppm")⁽¹⁾, with a mean concentration of 1,092 mg/kg. Total base/neutral concentrations ranged from 23 mg/kg to 447 mg/kg, with a mean concentration of 147 mg/kg. Total acid extractable concentrations ranged from non-detected to 58.2 mg/kg, with a mean concentration of 12 mg/kg. Total PCBs ranged from non-detected to 15,000 mg/kg, with a mean concentration of 1,048 mg/kg. Total cyanides ranged from non-detected to 34 mg/kg, with a mean concentration of 4.7 mg/kg. Total phenolics ranged from non-detected to 600 mg/kg, with a mean concentration of 50 mg/kg. Total petroleum hydrocarbons ranged from 290 mg/kg to 81,600 mg/kg, with a mean concentration of 13,167 mg/kg. Two pesticides and twelve metals were also detected.

(1) In the following paragraphs, the mean values discussed were calculated using only concentrations detected above the method detection limits.

Within the saturated portion of the fill, total volatile organic concentrations ranged from non-detected to 9,890 mg/kg, with a mean concentration of 2,069 mg/kg. Total base/neutral concentrations ranged from non-detected to 3,913 mg/kg, with a mean concentration of 343 mg/kg. Total acid extractable concentrations ranged from non-detected to 801 mg/kg, with a mean concentration of 169 mg/kg. Total PCBs ranged from non-detected to 350 mg/kg, with a mean concentration of 62 mg/kg. Total cyanides ranged from non-detected to 32 mg/kg, with a mean concentration of 8.5 mg/kg. Total phenolics ranged from non-detected to 683 mg/kg, with a mean concentration of 66 mg/kg. Total petroleum hydrocarbons ranged from 36 mg/kg to 29,600 mg/kg, with a mean concentration of 8,507 mg/kg. Three pesticides and twelve metals were also detected.

Within the top one foot of the clay which underlies the fill, total volatile organic concentrations ranged from non-detected to 1,822 mg/kg, with a mean concentration of 153 mg/kg. Total base/neutral concentrations ranged from non-detected to 174 mg/kg, with a mean concentration of 20 mg/kg. Total acid extractable concentrations ranged from non-detected to 23 mg/kg, with a mean concentration of 9.2 mg/kg. Total PCBs ranged from non-detected to 5.4 mg/kg, with a mean concentration of 1.8 mg/kg. Total cyanide was detected in only one sample, at a concentration of 3.5 mg/kg. Total phenolics ranged from non-detected to 65 mg/kg, with a mean concentration of 6.6 mg/kg. Total petroleum hydrocarbons range from non-detected to 5,780 mg/kg, with a mean concentration of 1,164 mg/kg. One pesticide and twelve metals were also detected.

Within the remaining portions of the clay, total volatile organic concentrations ranged from 0.048 mg/kg to 4,124 mg/kg, with a mean concentration of 361 mg/kg. Total base/neutral concentrations ranged from non-detected to 1.2 mg/kg, with a mean concentration of 0.46 mg/kg. Total acid extractable concentrations ranged from

non-detected to 0.434 mg/kg, with a mean concentration of 0.336 mg/kg. Total PCBs ranged from non-detected to 0.370 mg/kg, with a mean concentration of 0.19 mg/kg. Total phenolics ranged from non-detected to 1.6 mg/kg, with a mean concentration of 1.5 mg/kg. Total petroleum hydrocarbons ranged from non-detected to 102 mg/kg, with a mean concentration of 82.5 mg/kg. Eight metals were detected, while pesticides and total cyanides were not. Except for volatile organics, the mean concentrations of the organics decrease within the clay by an order of magnitude or more from the top foot of clay. At two of the three locations where samples were collected through the clay, volatile organic concentrations did not decrease with depth, but rather, however, at the other locations where the clay is thickest, the volatile organic concentrations do attenuate with depth to less than 1 mg/kg.

Two water-bearing units were investigated during the RI: the fill material and the glacial till. The fill (or water table) aquifer occurred at a depth of two feet below grade, and exists under unconfined (perched) conditions. The second water-bearing unit consists of the glacial till stratum occurring between the clay and bedrock. The till aquifer occurs under confined to semi-confined conditions.

Within the water table aquifer, total volatile organic concentrations ranged from 2.7 mg/l to 2,564 mg/l, with a mean concentration of 538 mg/l. Total base/neutral concentrations ranged from 0.018 mg/l to 68 mg/l, with a mean concentration of 14 mg/l. Total acid extractable concentrations ranged from 0.023 mg/l to 17.8 mg/l, with a mean concentration of 3.7 mg/l. Total PCBs ranged from non-detected to 17 mg/l, with a mean concentration of 4.33 mg/l. Total cyanides ranged from non-detected to 4.52 mg/l, with a mean concentration of 0.96 mg/l. Total phenolics ranged from 0.062 mg/l to 42.5 mg/l. with a mean concentration of 8.8 mg/l. Total petroleum hydrocarbons ranged from less than 1 mg/l to 2,270 mg/l, with a mean concentration of 220 mg/l. Five pesticides and nine metals were also detected.

Within the till aquifer, total volatile organic concentrations ranged from 0.026 mg/l to 55 mg/l. The volatile organics found in the till aquifer are also found in the water table aquifer. This indicates that contaminants are moving downward from the water table aquifer to the till aquifer. Other compounds detected in the till aquifer include phenols, 1,2-dichlorobenzene, and nitrobenzene, which are all found in the water table aquifer, and PCB quantified as Aroclor 1232, all at concentrations below 0.1 mg/l. Two metals were also detected. The flow direction in the till aquifer is towards the northwest.

Surface water and sediment sampling was performed at four stations along Peach Island Creek: at the confluence of Peach Island Creek and Berry's Creek, approximately one-half mile downstream from the SCP site (Station 1); 100 feet downstream from the SCP site (Station 2); adjacent to the centerline of the SCP site (Station 3); and 100 feet upstream from the SCP site (Station 4).

Most of the organic chemicals detected in the waters of Peach Island Creek were volatile organic compounds. The total volatile organic concentrations ranged from 0.012 mg/l to 0.143 mg/l, with a mean concentration of 0.067 mg/l. Other compounds detected in the creek water include total phenolics and metals. These compounds were all found in the soils and ground water at the site.

Within the creek sediments, total volatile organic concentrations ranged from 0.391 mg/kg to 16,241 mg/kg; base/neutral concentrations ranged from 2.92 mg/kg to 578 mg/kg; acid extractable concentrations ranged from non-detected to 44.7 mg/kg; PCBs ranged from non-detected to 770 mg/kg; total cyanides ranged from 1.2 mg/kg to 205 mg/kg; total phenolics ranged from 1.1 mg/kg to 315 mg/kg; and total petroleum hydrocarbons ranged from 1,800 mg/kg to 25,900 mg/kg. Twelve metals were also detected. The chemical contaminants found in the sediments of the Creek are also found in the soils and ground water.

In summary, a wide variety of contaminants are present within the unsaturated and saturated soils at the site. Most of the contaminants which are also present in the shallow ground water have migrated through the clay layer into the water within the till aquifer, as well as into the sediment and surface water in Peach Island Creek.

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1.0 INTRODUCTION

1.1 SITE BACKGROUND INFORMATION

The Scientific Chemical Processing (SCP) site is located at 216 Paterson Plank Road in Carlstadt Borough, Bergen County, New Jersey, at latitude 40° 49' 30" N, longitude 74° 04' 38" W. The site is a corner property, bounded by Paterson Plank Road on the south, Gotham Parkway on the west, Peach Island Creek on the north, and an industrial facility on the east (Figure 1).

The land on which the SCP site is located was purchased by Patrick Marrone in 1941, who eventually sold it to a predecessor of Inmar Associates, Inc. The date of this transaction is not available. While Marrone owned the site, it was reportedly used for solvent refining and solvent recovery. One reported operator included Scientific Chemical Treatment Company. Aerial photographs dated 1951, 1959, 1961, 1962, 1968, 1969, 1970, 1976 and 1978 indicate storage of drummed materials on the site; a 1962 air photo most clearly indicates this. On October 31, 1970, the Scientific Chemical Processing Company, Inc., leased the Carlstadt site from Inmar Associates (Reference 1). On September 20, 1977, Inmar Associates purchased the adjoining lots from Patrick Marrone and added them to the land SCP had been leasing (Reference 2). SCP used the site for processing industrial wastes from 1971 until it was shut down by a court order in October, 1980 (Reference 1).

While in operation, SCP received liquid by-product streams from chemical and other industrial manufacturing firms, then processed the materials to reclaim marketable products, such as methanol, which were sold to the originating companies. In addition, other liquid hydrocarbons were processed to some extent, then blended with fuel oil, and the mixtures were typically sold back to the originating companies, or to cement and aggregate kilns as fuel.

In addition to the wastes and recyclables noted above, the site also received other wastes, including paint sludges, acids and other unknown chemical wastes.

Operations at the site ceased in 1980. At that time, over 300,000 gallons of waste and recyclable materials were stored on the site (Reference 1). These have since been removed. They were primarily in liquid form and included (Reference 3):

- o #2 Fuel oil
- o Fuel, fuel residue and water mixture
- o Methanol/phosphoric acid solutions
- o Etching solutions
- o Solvents and thinners

The latter encompassed the following compounds (Reference 3):

- | | |
|------------------------|------------------------------|
| o Benzene | o Methyl isobutyl ketone |
| o Carbon tetrachloride | o Paint and pigment residues |
| o Chloroethane | o Phenolic resin |
| o Chloroform | o Styrene |
| o Ethylbenzene | o Tetrachloroethane |
| o Ethylacetate | o Tetrachloroethylene |
| o Isopropanol | o Toluene |
| o Methylene Chloride | o Trichloroethane |
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| o Methyl ethyl ketone | o Xylenes |

1.1.1 Site Layout

The site occupies a relatively flat, sparsely-vegetated area of approximately 5.9 acres. It is fenced on three sides (east, west, south), with the main entrance gate located on Paterson Plank Road, near the southeast corner of the site. Operational areas included (Figure 2):

- o Tank farm
- o Drum storage areas
- o Still and boiler house
- o Staging platform and thin-film evaporator

The tank farm had an unlined containment area that was depressed 1-2 feet with respect to the surrounding surface elevations. At one time, the tank farm contained 18 tanks. Presently, only one tank remains at the site. This tank was placed inside a roll-off container and contains sludge with extremely high levels of PCBs. The structural integrity of this tank is suspect. Streaks of discoloration appear on the sides of the tank, which has been patched (in at least one location that is visible) with sealant braced by a cinder block.

The drum storage areas are now vacant, after nearly 4,000 drums were reportedly removed to the firm's Newark site sometime between May 1979 and December 1980. These drum storage areas, comprising the southeastern half of the site, were unlined and had no spill containment provisions, although a concrete pad existed in one area.

The still and boiler house section of the site contained tank trailers used to receive and feed substances run through the still. The USEPA and NJDEP reported that the structural integrity of the tanks on the tank trailers (which have been removed off-site) was also suspect, with discoloration indicating the possibility of leaks. Furthermore, one of the removed tank trailers was heavily patched with epoxy sealants and makeshift wooden braces. The former still site was surrounded by a small dike, but the trailer parking slots were not.

The staging platform was used for transferring and storing wastes. The thin-film evaporator and adjoining small tank farm, which contained 10 tanks, were surrounded by a cinderblock dike which was broken in several places.

Additional features on the site included:

- o Two abandoned small buildings near the site entrance reportedly used as a garage and office;
- o Two possible sludge disposal areas near the northeastern corner of the site (a 1979 aerial photograph shows a lagoon or sludge pit in the northeast quadrant of the site);
- o The cut portion of tank buried near the tank farm (contents and configuration unknown);
- o A few soil and miscellaneous debris mounds, possibly generated during the initial remedial measures and the dismantling of the facility;
- o Miscellaneous debris, including crushed drums, strewn throughout the site;
- o Some seeps of discolored ground water discharging into the Peach Island Creek, observed by Dames & Moore personnel during a July 1985 site visit; and
- o Patches of discolored soil at various locations throughout the site.

1.2 NATURE AND EXTENT OF THE PROBLEM

Although the above-ground sources of organic and inorganic chemical contaminants were removed, the extent of any residual contamination in surface and subsurface soils, ground water, and Peach Island Creek sediments and water was not known. It was, therefore, necessary to conduct an investigation to obtain that information in

order to evaluate the nature and extent of the residual contamination and the threat posed by the site to the public health and/or the environment.

1.3 REMEDIAL INVESTIGATION SUMMARY

This investigation was designed to evaluate the existence, type and extent of contamination at the SCP site, and to assess the effects of any such contamination on the public health and/or the environment.

The investigation consisted of:

- o research of historic sources
- o magnetometer survey
- o terrain conductivity survey
- o seismic refraction survey
- o shallow soil borings
- o piezometer installation
- o shallow well installation
- o shallow well slug testing
- o deep soil borings
- o deep well installation
- o sampling and chemical analysis
 - soil samples
 - ground water samples
 - stream sediment samples
 - stream water samples
- o sampling and engineering testing of soil samples
- o ground water level measurements
- o surface water level measurements

1.4 OVERVIEW OF THE REPORT

Section 2.0 of the report presents the site features investigation. Section 3.0 presents a review of the organic and inorganic chemical contaminants that were identified on site, as well as

their physiochemical characteristics pertinent to their environmental transport and fate. Section 4.0 addresses the hydrogeologic investigation, which includes information on geology, soils and ground water. Section 5.0 describes the surface water investigation, including water and sediment sampling at Peach Island Creek. Sections 6.0 (Air Monitoring), contains a brief discussion related to the air monitoring conducted during this investigation.

2.0 SITE FEATURES INVESTIGATION

2.1 DEMOGRAPHY

The Borough of Carlstadt is located in Bergen County, New Jersey. In 1980 (the most recent year for census data, Reference 4), the borough had 6,166 residents: 2,978 male and 3,188 female. The median age was 33.9 years. The average per capita income was \$7,757. In 1980, 62.1% of the borough residents possessed high school diplomas. The borough occupies a total area of 4.20 square miles. The average population density was 1,468.8 persons per square mile. In 1980 there were 2,393 housing units available. Of a total of 2,030 parcels of land listed on the tax maps, 133 were vacant, 1,481 were designated as residential and apartments, 415 as commercial and residential, and one as a farm. The Borough is served by the Hackensack Water Company and sanitary sewer services are provided by the Bergen County Sewer Authority. Although the majority of the population lives within the residential and commercial areas of the borough, three dwelling units exist in the light industrial area within approximately 1 mile of the site on Washington Avenue and are shown on Figure 1. None of these three units is known to have wells.

2.2 LAND USE

The land use in the vicinity of the site is classified as light industrial by the Borough of Carlstadt Land Use Planning Map (Figure 3). The establishments in the immediate vicinity of the site include a bank, animal dwellings (stables), warehousing, freight carriers, light chemical, leather goods, electronics and service sector industries (Figure 4).

The land lying along Berry's Creek and Peach Island Creek has been classified as waterfront recreation zones. The site is adjacent to the Meadowlands Sports Complex, a large facility for professional sports and public events.

Approximately 1.5 miles north of the site is the Teterboro Airport, which serves private planes and light jet planes.

2.3 NATURAL RESOURCES

2.3.1 Setting

The SCP site is located within the Hackensack Meadowlands. This is an extensive area of salt water marshes that are drained by the Hackensack River and its tributaries. Of those tributaries, Berry's Creek drains approximately 800 acres of marshland. Berry's Creek receives the waters of a number of drainage ditches and natural tributaries. One of the tributaries of Berry's Creek (Peach Island Creek) flows adjacent to the site (Figure 3).

2.3.2 Geography

The National Wetlands Inventory map for the area (Reference 6A) classifies the site as an upland area, which indicates that there are no wetlands on the site. The surface soils at the site consist of fill

material. Wetlands in the vicinity of the site are classified locally (Reference 6) as Class IV (Reed Marsh). Two of these wetland areas, Walden Swamp and Eight-Day Swamp, are drained by Berry's Creek and its tributaries, one of which is Peach Island Creek (Reference 6).

2.3.3 Biota

A literature search of available published information in the vicinity of Peach Island Creek was performed for Dames & Moore by the New Jersey Marine Science Consortium in November, 1985 (Reference 7). No specific information was found relative to Peach Island Creek. The literature did identify information for Berry's Creek, into which Peach Island Creek flows. Though this information is outdated, the results of the literature search are quoted below:

"Berry's Creek is lined on both side with heavy growths of common reed grass (Phragmites communis and P. australis) (United States Army Corps of Engineers, 1975). Near the ditch that parallels the existing embankment of the Sports Complex, Springtails (Collembola sp.) are abundant. The tidal marshes (mudflats) are predominately covered by Cordgrass (Spartina alterniflora) and Salt Hay (S. peters) NJDEP, 1979). Aquatic vegetation consists primarily of blue-green algae mats and duckweed (COE, 1975).

No macroscopic invertebrates were found in any dredge or net samples. Occular examination also revealed no macroscopic invertebrates (J. McCormick Assoc., 1975).

Mosquito adults and larvae are present in large numbers at certain times of the years. Populations of Dragonflies have also been documented in the region (COE, 1975).

Specimens of snails (Physa spp.) have been obtained from the diked section of the Sports Complex (JMA, 1975).

Grass Shrimp (Palaemonetes vulgaris) are seasonally abundant in Berry's Creek (COE, 1975). J. McCormick Assoc. reported the largest concentrations in the spring and summer. The Blue Crab (Callinectes sapidus), perhaps the only commercially valuable

species, has been observed in the creek (NJDEP, 1979). However, population surveys for the Blue Crab are unavailable.

Multiple collections by several agencies (HMDC, NJDEP, COE) show the killifish to be the predominant finfish in the Berry's Creek region. Two species of killifish, the Common Mummichog (Fundulus heteroclitus) and Striped Mummichog (F. majalis) occur all year round (JMA, 1975). Although no statistical population surveys are available, all literature indicate that the killifish are abundant. On occasion, Carp (Cyprinus carpio) and White Perch (Morone americana) have been collected, however their occurrence is rare (COE, 1975).

J. McCormick Associates (1975) reported that snapping turtles utilize the tidal marsh habitat in the region. Data on their numbers or movement were unavailable. No macroscopic invertebrates were reported in the areas sampled in Berry's Creek. Benthic invertebrates, though, may be found in other areas, including Peach Island Creek."

Information from more recent studies (Reference 7A) identified additional plant species in the vicinity of Peach Island Creek. These include: narrow-leaved cattail, green foxtail grass, spikerush, soft-stem bulrush, water smartweed, Lamb's Quarters, tree-of-heaven, bittersweet nightshade, horse nettle, common mugwort, and annual wormwood.

The files of the Hackensack Meadowlands Development Commission were reviewed by Dames & Moore in August 1988. No additional ecological information was available regarding Peach Island Creek.

2.3.4 Ground Water

A review of well permit records at NJDEP revealed that permits had been sought for 57 wells within a two-mile radius of the Carlstadt site. A separate review by the New Jersey Geologic Survey confirms the results of this review (Reference 5). The results of this survey are summarized below:

Number of WellsReported Usage

51	Cooling and industrial
3	Unknown
2	Domestic
1	Lavatory

The approximate locations of these wells are shown on Figure 5 and listed on Table 1. The wells of known depth identified in the survey are all installed in the bedrock aquifer. The wells of unknown depth are all industrial or cooling wells.

The three wells of unknown usage include: Marathon Enterprises (No. 20), which did not respond to telephone or certified letter inquiries; Alpha Refining Co. (No. 28), which has no listing in Bergen County; and Stella Doro Co., Inc. (No. 44), which also did not respond to telephone or certified letter inquiries. The owners of the two domestic wells are both listed customers of the Hackensack Water Company. The well used for a lavatory belongs to Becton Dickinson & Co. (No. 12).

The Hackensack Meadowlands Development Commission has indicated in a recent personal communication with Dames & Moore that, to its knowledge, no potable water wells exist in the area. In any case, no wells have been identified in the shallow or till aquifers.

The United States Geological Survey (USGS) indicated that, regionally, the till aquifer is mineralized and the water is not suitable for human consumption (Reference 7B). The findings of the USGS report are summarized below:

"The chemical quality of ground water in the unconsolidated deposits in the Hackensack Meadows is highly influenced by the quality of water in the Hackensack River and waters that flood the meadows as a result of tides. Pumping has reversed the natural gradients and induces recharge from these generally

highly mineralized sources. For example, heavy pumping at Hackensack and near North Bergen has induced recharge of poor chemical quality from the Hackensack River into the sand and gravel aquifers.

As the upper area of the basin has become more urbanized and water demands have increased, progressively smaller quantities of fresh water have been permitted to enter the meadows from upstream sources of the Hackensack River. During the drought from 1960 to 1965 practically no fresh water flowed into the meadows. Furthermore, the lower area is used for disposal of 57 mgd of sewage and industrial wastes, an amount equivalent to about one-third average precipitation that falls on the area. The preceding combination of factors makes surface water of poor quality available for induced recharge to the unconsolidated deposits in the meadows. This water is suitable for cooling if precautions are taken to prevent corrosion by water that may have a chloride content of several thousand milligrams per liter."

In the same report, the quality of the bedrock aquifer is described as follows:

"Water pumped from the Brunswick in the lower area of the basin is hard to very hard (192 to 1,240 mg/l), contains moderate amounts of iron (.36 mg/l median), is alkaline (pH 7.3 to 7.7), and highly mineralized (specific conductance 579 to 3,480 micromhos per cm). Chloride concentrations range from 19 to 755 mg/l and sulfate concentrations from 87 to 966 mg/l. High sulfate concentrations may be related to the depth of the producing zone, as suggested by Herpers and Barksdale (1951, p. 37), but appear to be restricted to deep wells in the lower part of the basin where gradients in the flow system are low and movement of ground water is negligible. Thus, the high sulfate concentrations may represent the quality of water in the longest, deepest, and slowest moving flow path in the ground water-circulation system.

Ground water quality in the lower area of the basin, and in particular in the meadows, has been affected locally by heavy pumpage which has caused the intrusion of poor quality water from both the Hackensack River and Newark Bay. Herpers and Barksdale (1951) suggest that the intrusion of poor

quality water in the vicinity of Harrison and Kearny, N.J., may, in part, result from the dredging of canals in areas adjacent to Newark Bay and the Passaic River thereby exposing permeable material to the bay water. Other hydraulic connections between the Brunswick Formation and Newark Bay and Hackensack and Passaic Rivers may be through (1) sand deposits of Holocene age, (2) coarse-grained deltaic deposits formed by the ancestral Passaic River in Lake Hackensack during the Pleistocene (fig. 5), or (3) gravels of uncertain origin at the base of the pre-glacial or inter-glacial stream valley underlying Newark (Herpers and Barksdale 1951, p.20).

The high sulfate content causes hard scale in boilers and makes the water unsuitable for this use. The water in the Brunswick Formation in the lower area of the basin is suitable for cooling although some corrosion problems will be experienced because of the high chloride content."

2.3.5 Mineral Resources

There are no mines, quarries or gravel pits in the vicinity of the site. Only one (now closed) borrow pit was identified, approximately 3/4 of a mile north of the site.

2.4 CLIMATOLOGY

Climate and meteorological conditions at the site have been characterized from weather records available from the National Weather Service at Newark International Airport. The airport is located approximately nine miles south-southeast of the site in a similar physiographic setting. The data are considered representative of the site.

The climate of the site is humid and is typified by moist, warm summers and moderately cold winters with winds of moderate velocity. Prevailing winds in the area are from the southwest with only small seasonal variations in direction. The average annual temperature at the

airport between 1944 and 1983 was 53.9 degrees Fahrenheit. In the summer, there are long periods of time when the weather remains very hot, especially when the wind is from the west-southwest and a Bermuda high-pressure system is established. Cold temperatures in the winter are experienced when continental polar winds are blowing from the northwest (Reference 8). Wind rose diagrams showing predominant wind directions are presented in Appendix E.

The average annual precipitation for the area is approximately 42 inches based on the data from 1944 to 1983. Precipitation falls fairly uniformly throughout the year, although the region is influenced by seasonal tropical storms and hurricanes.

Evaporation studies performed in the area between 1956 and 1970 show that the average annual Class A pan evaporation for Newark is 49.7 inches. Pan evaporation is highest in the month of July at 7.0 inches and lowest in the month of December at 1.6 inches (Reference 9). Free water surface evaporation is the amount of water evaporated from a shallow lake, wet soil, or other moist, natural surface. It is roughly 70 percent of the evaporation from Class A pan for the same meteorological conditions. The annual free water surface evaporation for Newark is calculated to be approximately 35 inches. The average annual precipitation of 42 inches minus the average annual potential evaporation of 35 inches leaves an annual precipitation of approximately 7 inches which, in theory, is the amount of water available for ground water recharge and surface runoff.

3.0 HAZARDOUS SUBSTANCES INVESTIGATION

3.1 WASTE TYPE

Table 2 presents a list of the organic and inorganic chemical contaminants detected in the samples collected during the Remedial Investigation. Volatile, acid and base/neutral extractable organic

chemicals, pesticides, polychlorinated biphenyls (PCBs), metals, phenolics, cyanides and petroleum hydrocarbons were all identified at the site. Eighty-seven chemicals/classes of chemicals were detected in the various media sampled.

3.2 PHYSIOCHEMICAL PROPERTIES

Table 3 presents a tabulation of the chemical and physical parameters for each of the organic chemicals detected at the SCP site. Parameters indicative of the environmental transport and the fate of the organic substances include water solubility, vapor pressure, octanol/water partition coefficient, soil/sediment adsorption coefficient, specific gravity and mobility index. These parameters are discussed in the following paragraphs.

Water Solubility - provides a basis for comparison of the relative potential for mobility in water. Highly soluble organic chemicals are most easily distributed by the hydrologic cycle. These organic chemicals tend to have relatively low adsorption coefficients for soils and sediments and relatively low bioconcentration factors in aquatic life (References 10 and 11).

The water solubilities presented in Table 3 indicate that the volatile organic compounds are generally of several orders of magnitude more soluble than the base/neutral extractable compounds and substantially more water soluble than the pesticides and polychlorinated biphenyls (PCBs). Therefore, these volatile compounds are likely to be more mobile. Solubility values listed are equilibrium values for pure deionized water at standard temperature and pressure; actual site conditions may alter these values, as well as the other values listed in Table 3 and described below.

Vapor Pressure - The vapor pressure is of primary significance at interfaces like soil/air and surface-water/air. Vapor pressure provides an indication of the tendency of pure substances to vaporize in an undisturbed condition (i.e., without agitation or stirring), and thus provides a method for ranking the relative volatilities of organic chemicals (Reference 12). Organic chemicals with relatively high vapor pressures may be subject to release to the ambient air via volatilization.

Octanol/Water Partition Coefficient (K_{ow}) - indicates the tendency of an organic chemical to partition itself between an organic phase (e.g., organics in soil, sediment, fish) and an aqueous phase. It is defined as the ratio of a chemical's concentration in the octanol phase to its concentration in the aqueous phase of a two-phase octanol/water system. The octanol/water partition coefficient can be related to other parameters such as water solubility, soil adsorption coefficients and bioconcentration factors for aquatic life. Organic chemicals with low octanol/water partition coefficient values (e.g., less than 10) may be considered relatively hydrophilic. They tend to have high water solubilities, small sediment/soil adsorption coefficients, and small bioconcentration factors for aquatic life. Conversely, organic chemicals with high octanol/water partition coefficient values (e.g., greater than 10^4) are very hydrophobic (Reference 10).

Soil/Sediment Adsorption Coefficient (K_{oc}) - may be thought of as the ratio of the amount of chemical adsorbed per unit weight of organic carbon in the soil or sediment to the concentration of the chemical in solution at equilibrium. This parameter indicates the tendency of a chemical to bind to soil particles containing organic carbon, and presents a measure of the mobility of chemicals in the subsurface environment. Chemicals with relatively high soil adsorption coefficients (such as base/neutrals, pesticides and PCBs) are generally immobile in the subsurface environment and are not subject to ground water advection or diffusion, but are subject to transport via erosional processes if present in surface soil material. The soil/sediment

adsorption coefficients presented in Table 3 were calculated using the equations listed at the end of the table (Reference 10).

Specific Gravity - indicates whether a chemical in its pure form is more dense or less dense than water, and is generally useful in cases where chemicals are present at the surface or are present in ground water at very high concentrations (Reference 14).

Mobility Index - is a number proportional to a chemical's probability of escaping its point of origin and migrating through the air or water. It is calculated by the following equation (Reference 15):

$$\text{Mobility Index} = \log (\text{water solubility} \times \text{vapor pressure} - K_{oc}),$$

where K_{oc} = the soil/sediment adsorption coefficient.

A log function is used only to reduce the size of the numbers. The higher the mobility index, the more mobile the chemical is in the environment. A relative scale for describing mobility is provided below (Reference 15):

<u>Mobility Index</u>	<u>Mobility Description</u>
greater than 5.00	extremely mobile
0.00 to 5.00	very mobile
-5.00 to 0.00	slightly mobile
-10.00 to -5.00	immobile
less than -10.00	very immobile

An examination of Table 3 indicates that the environmental behavior of the volatile organic/acid extractable compounds is markedly different from the base/neutral and pesticide/PCB compounds. Volatile organics and acid extractable compounds generally have higher water solubilities and vapor pressures than the base/neutral and pesticide/PCB compounds. The volatiles and acid extractable compounds are therefore more susceptible to hydrogeologic and atmospheric transport. They volatilize more readily if present in surface soil or surface water.

Their relatively high water solubilities make them prone to leaching by infiltrating precipitation and subject to ground water transport.

On the other hand, the base/neutral and pesticide/PCB compounds are relatively insoluble in water and have lower vapor pressures. These characteristics are reflected by their relatively high soil/sediment adsorption coefficients. These substances are not as susceptible to volatilization or to ground water transport and tend to adsorb onto soil particles. If spills of these substances occur, the primary mechanism by which they may be transported is carrying of particulates with surface water runoff or by wind transport of particulates.

As evidenced in Table 3, approximately half of the organic compounds detected at the site are very mobile (volatile organics, acids), while the other half are immobile or slightly mobile (base/neutrals, PCBs and pesticides).

4.0 HYDROGEOLOGIC INVESTIGATION

4.1 GEOLOGY

4.1.1 Objectives and Methods

An understanding of the spatial relations of the different soil units as well as their geologic history is essential in interpreting and modeling the site hydrology and contaminant distribution. The control and significance of the geology in any remedial action cannot be over-emphasized.

To interpret the site geology, information was obtained from:

- o on-site soil borings;

- o review of subsurface information from the site vicinity; and
- o review of information of regional significance.

4.1.2 Geologic Setting

The site is located within the Piedmont Geologic province of New Jersey. The area is underlain by the Triassic age Newark Supergroup bedrock (predominantly shales and sandstones). The advancing ice front of the Wisconsin Glacial Event eroded valleys into the underlying rocks. In the area occupied by the present-day Hackensack Meadowlands, these valleys have a north-south orientation. Till was deposited over the scoured bedrock. When the glacier began retreating, a glacial lake formed between the ice front and the terminal morrain. Fine grained sediments were deposited in this lake.

Overlying the glacial sediments, a sequence of marine and marsh sediments complete the sequence of natural sediments. Man-made fill was placed above the marsh deposits in order to develop the land.

4.1.3 Site Geology

Based on information obtained from soil borings drilled during this investigation, the stratigraphy at the site is identified as follows, in descending order:

- o fill
- o peat
- o gray silt
- o varved clay
- o till
- o bedrock

Each of these units is described below. A composite geologic section is shown on Figure 7. For locational references, see Figure 6.

Fill

The site is covered by soil mixed with man-made fill. The composition of this fill is extremely variable and heterogeneous. The fill is thinnest near Peach Island Creek and increases in thickness toward Paterson Plank Road. This may be a consequence of the emplacement (dumping) procedures. The fill thickness ranges from 3 to 11 feet, with an average thickness of approximately 8.4 feet.

Peat

Peat is the youngest of the naturally-occurring materials at the site. Its thickness decreases from Peach Island Creek to Paterson Plank Road and in places it is completely absent. This is, most likely, due to the high water content of peat (published values up to 1040% - Reference 16), which causes the peat to be displaced when fill is placed over it. The peat thickness ranges from 0 to 7 feet, with an average thickness of approximately 1.8 feet. At one location (RMW-1S), fine sand, which appears natural, overlies the peat, indicating the presence of localized channel scouring and filling.

Gray Silt

In sharp contact with the peat is a silt layer of almost constant thickness (approximately 2 feet) throughout the site. Generally, this is massive, (i.e., bedding is not readily observable) except for rare laminations. This material is extensively mottled, indicating reducing conditions. The nature of the reducing material could not be identified from field observations.

Varved Clay

In sharp contact with the overlying gray silt is a wedge-shaped unit of varved clay, thickest toward Peach Island Creek and thinner

towards Paterson Plank Road. The thickness of this material ranges from 0 to 18 feet. The upper surface is approximately horizontal, while the lower surface is inclined. The literature (Reference 17) mentions the presence of "desiccated varves" which, however, were not encountered at the site. Investigations at the former Glacial Lake Passaic revealed that the varved clays of that location were disrupted by microfaulting (probably as a result of strong ground motions due to earthquakes). No such features were observed at the site. X-ray diffraction work on the varved sediments of Glacial Lake Passaic indicates that they contain quartz, feldspar, amphibole, illite, kaolinite, chlorite, smectite and mixed-layer minerals (Reference 18). It is probable that the on-site varved clays have similar composition.

Proceeding from Peach Island Creek to Paterson Plank Road, the varved clay yields to a massive red clay unit (0 to 8 feet in thickness) and a sand unit. The nature of the contact can only be inferred, but it appears that the varved clay onlaps the red clay and possibly the sand unit. However, the sand unit could be channel scoured- and-fill into the varved clay. In this latter case, a stream channel could have been eroded into the clay, and then naturally backfilled with sand. For clarity of illustrations, this unit was omitted on Figure 7.

Till

The deepest unconsolidated unit at the site is the Wisconsin till, approximately 20 feet thick. Within this unit three separate members can be identified:

- o clean sand
- o massive clay
- o sand and gravel

For clarity of illustration, these three units are not differentiated on Figure 7.

Clean Sand

This unit was identified only in RMW-1S and occurs at the top of the till. The exact genetic relation of this sand to the till is not clear (due to the limited information available). Two explanations for its origins are available: erosion of a stream channel into the underlying clay and deposition in the stream bed (scour and fill) or fluvioglacial deposition over the massive clay.

Massive Clay

A wedge-shaped body of massive (i.e., bedding is not readily discernible) red clay occupies the top of the till. This unit is thickest towards Paterson Plank Road and attenuates rapidly towards Peach Island Creek.

Sand and Gravel

This unit comprises the bulk of the till and is a heterogeneous mixture of sand and gravel.

Bedrock

On the basis of on-site borings which penetrate to bedrock, the bedrock is identified as reddish brown shale of the Brunswick Formation. Information on bedding and fractures is not available, since the bedrock was not studied during this investigation.

Information from the on-site borings, combined with information from work performed for the Meadowlands Sports Complex (Reference 16), indicate that the site is located on the eastern flank of the north-south trending glacial valley, very near the ridge that separates this valley from the one to the east. Review of published information indicates that

the surface morphology of these valleys can be very irregular (Reference 17).

To evaluate the on-site geologic conditions and provide continuity between borings, seismic refraction profiles were performed across the site at locations shown on Figure 8.

Standard 14 Hz, vertical geophones were placed at 25-foot intervals along the spread. A 12-channel Geometrics Model ES-1200 signal enhancement seismograph was used for recording. The signal enhancement seismograph permits the successive summation of waveforms from individual hammer impacts. True seismic signals are enhanced by the summation while random noise tends to be cancelled. Thus, the system can provide the capability of using relatively small energy sources and/or recording in noisy environments.

Based on the relative uniformity of interpreted depths and velocities, it does not appear that any substantial irregularity on the bedrock occurs over the area covered by this survey. Depths are consistent with those observed during drilling of the till wells. The portions of the seismic program completed on February 27 and 28, 1988, coupled with drill hole data, make the probability of an undetected bedrock ridge quite low. On this basis, it was concluded that further seismic refraction work was not necessary and the program was terminated.

Seismograms were analyzed for the time of wave travel from the shot point to each geophone position. These travel times were plotted against distance from the shot point. Straight line segments were drawn through the arrival time data and these were used to determine apparent seismic wave velocities and velocity layering. A conventional time-intercept method of analysis was used to compute the depth of layer interfaces.

Given the relatively low signal noise ratio that dominates the recordings, some ambiguity in the onset time of seismic signal occurs, particularly for the geophone positions more distant from the energy source. The analysis of the recordings for the onset times results in a generally consistent pattern characterized by three subsurface layers. Therefore, a three-layer solution has been used for all of the data sets. In some cases, construction of the straight-line segments results in only two geophone positions defining a velocity layer.

The interpreted depths to bedrock from this straightforward method of analysis indicate very little deviation from the depths to bedrock noted in the till wells. Excluding the west and south ends of Lines 1 and 6, all of the interpreted depths fall approximately within an error band of ten percent using a depth of 59.6 feet (Figure 8). At the intersection of Lines 1 and 6, the depth appears to be slightly greater, averaging approximately 68 feet. Under circumstances where the signal to noise ratio is favorable, depth calculations are generally accurate to within plus or minus ten percent. Because of the character of the recordings used in this analysis, the potential error factor should be considered to be somewhat larger.

Reversed profile shooting is used to provide an indication of dipping interfaces through a comparison of the apparent refractor velocities from the two end shots on a spread. Dip is indicated when one direction shows a velocity significantly higher than the other direction. The apparent bedrock velocities interpreted from this survey do not suggest the occurrence of step dip on the interface.

Figure 9 is a block-diagram of the interpreted bedrock surface. The seismic information indicates that the overlying till has a similar configuration.

A bedrock investigation is currently underway; this investigation will involve coring the bedrock and monitoring well

installation. The results and evaluation of this investigation will be included in a separate report, upon completion.

4.2 SOILS

4.2.1 Objectives and Methods

The objectives of this phase of the investigation were to:

- o evaluate thickness and composition of the on-site soils; and
- o evaluate the nature of contamination present in the on-site soils.

In order to obtain this information, a total of 37 borings were drilled. The boring locations were biased toward areas where organic and inorganic chemical compounds were most likely to be detected. The selected locations were based on site history and operations, geophysical survey results, and visual observations of the site surface. All borings were advanced using either rotary wash technique or hollow-stemmed augers, with two exceptions. The borings for MW-5D and MW-7D were advanced using mud-rotary techniques when drilling through the till. The depth of these borings ranged from several feet to 62 feet below the ground surface. Soil samples were collected using either a 2-inch I.D. or a 3-inch I.D. split-barrel sampler. Most of the borings were sampled continuously, except for the lower portions of the till borings which were sampled at 5-foot intervals. Portions of selected samples were submitted for chemical analysis, while other samples were analyzed for their engineering properties. In addition, undisturbed samples were collected using 3-inch diameter Shelby tubes, to determine the permeability of clayey soils. All the samples were logged and described in terms of composition, texture and structure. A complete description of sampling and equipment cleaning procedures is presented in the Project Operations Plan dated March 4, 1987.

The original soil investigation was carried out in June and July, 1987. The borings were labeled to indicate their ultimate purpose. Thus, P-1 through P-4 were shallow borings drilled in the unsaturated and saturated fill, in which piezometers were installed; MW-1S, -3S, -4S and -6S were shallow borings drilled in the unsaturated and saturated fill, in which shallow monitoring wells were installed; MW-2D, -5D and -7D were till borings drilled to bedrock, in which deep monitoring wells screened in the till were installed; and B-1 through B-6 were shallow borings drilled in the unsaturated and saturated fill strictly for obtaining soil samples for chemical analyses. Shallow wells MW-2S, -5S, and -7S were installed adjacent to the corresponding till wells in borings from which no samples were collected for chemical analyses. A total of 20 borings were drilled.

Resampling was performed in November and December, 1987, after all soil and sediment chemical analytical data were rejected by Dames & Moore's quality assurance program. The same nomenclature was retained as in the original investigation, except that the letter "R" (for replacement) was added as a prefix to the boring and sample designations. For example, boring P-1, in which piezometer P-1 was installed, was replaced by RP-1, the subsequent adjacent boring from which soil samples were collected for chemical analysis. A total of 17 borings were drilled (no borings were drilled for MW-2S, -5S and -7S because no samples for chemical analysis had been collected from these borings during the original investigation).

At each of the 17 boring locations, samples were collected for chemical analysis from depth intervals of 0 to 2 feet (unsaturated fill), 5 to 6 feet (saturated fill), and top of clay. Continuous samples for chemical analysis were collected within the clay in the three till borings (RMW-2D, -5D and -7D), while boring RMW-1S was extended to the top of the till to obtain stratigraphic information. No soil samples were collected in the till stratum for chemical analysis. Borings that extended beneath the base of the fill were cased to the top of clay to

avoid introducing any chemicals to the lower units. Upon completion all the replacement borings were abandoned by pressure grouting to ground surface.

Ten additional shallow piezometers (P-5 through P-14) were installed in the fill during early March, 1988. Only stratigraphic sampling was performed in these piezometer borings; no samples were collected for chemical analysis.

A location plan is provided on Figure 6 (the replacement borings with the "R" prefix are not shown but were located adjacent to the original borings). Generalized cross-sections are shown on Figures 10 and 11. Boring logs are included in Appendix A.

A magnetometer survey of the site was performed in order to evaluate underground ferromagnetic materials, such as buried tanks or drums. Because of the large amounts of scrap metal that are scattered at the surface throughout the site, magnetic data are very "noisy". In addition, reinforcing rods in the foundation slabs of the (now demolished) storage sheds and tank farms tend to produce large areas of significant magnetic anomalies. Thus, no positive identifications are possible from the data. The only signatures that could perhaps be true are located in a small area to the north-northeast of the demolished storage shed and linear anomalies north-east of the old tank farm. Further interpretation cannot be produced at this point and additional exploration might be warranted before any ground intrusive remedial activities are initiated. The raw data are included in Appendix C.

4.2.2 Types of Soils

4.2.2.1 Surface Soils (Fill)

There are no natural surface soils at the site. Instead, the site is covered with construction debris and earthen fill material that

was brought in from elsewhere. These materials have a wide range of composition and particle size. Concrete, shingles, wood, brick, crushed stone, red shale blocks, sand and gravel were some of the materials that were identified in the fill, in sizes ranging from less than 1 inch to well over 6 inches. The thickness of this unit ranges from 3 to 11 feet, with an average thickness of approximately 8.4 feet. (See the discussion on peat in Section 4.2.2.2.)

Boring RB-1 penetrated a sludge pit that extended through the fill. The sludge had an appearance and consistency similar to automotive grease. The sludge extends from just below grade (a thin crust of soil overlies the sludge) to a depth of approximately 11 feet below grade, although the bottom may be peat. The depth was measured by pushing a small-diameter steel pipe through the sludge until resistance was encountered; sand was evident at the pipe tip upon withdrawal. The 0 to 2-foot and 5 to 6-foot samples were collected with hand augers because of a concern that the surface soils over the sludge would not support a drill rig. The top of the clay sample was collected from a boring drilled adjacent to the sludge pit.

4.2.2.2 Subsurface Soils

Three main types of subsurface soils are present at the site:

- o peat
- o silt and clay (including the upper till unit) *see clay*
- o sand and gravel

Peat

This soil is made up of decayed plant material. The degree of decomposition is variable, depending (in part) on the types of the parent vegetative matter. Varying proportions of silt and clay are mixed with the organic matter. This unit has a very high water content and is

easily displaced when debris is placed on it. The thickness of this unit ranges from 0 to 7 feet, with an average thickness of approximately 1.8 feet. The peat will be addressed with the fill in a general sense in the balance of this report, since both overlie the clay. Thus, with the peat included, the average fill thickness is approximately 10 feet, with a depth range of approximately 8.5 to 13 feet.

Silt and Clay

A 3 to 28-foot thickness of silt and clay⁽²⁾ (and mixtures thereof) exists across the site. Tables 4 and 5 list the results of classification tests and laboratory permeability tests, respectively, performed on samples of the silt and clay. A number of distinct members can be identified:

- o gray silt
- o varved clay
- o red clay

Gray Silt

This unit comprises approximately 2 feet of gray to greenish-gray silt, occasionally with small amounts of clay, often mottled olive green, occasionally laminated.

(2) An approximately 3-foot thickness of grey to greenish grey silt and clay was encountered at boring RMW-1S (see Appendix A, Volume II). The distinction between the grey silt and the varved clay was not apparent at this boring.

Varved Clay

The thickness of this material ranges from 0 to 18 feet. The average varve couplet thickness is on the order of 0.2 inches. The composition varies from clayey silt to clay or from fine sand to clay.

Red Clay

Massive clay and silt, 0 to 8 feet in thickness, extend beneath the varved clay. Although geologically the red clay is part of the till unit, it will be considered as part of the overall silt/clay stratum in the balance of this report.

Sand and Gravel (Till)

Approximately 20 feet of sand and gravel underlies the clay. The particle size distribution of this material is very irregular, and reflects its mode of origin. The coarser-grained portions are saturated with ground water.

4.2.3 Soil Quality

Chemical analyses of soil samples were performed on at least three samples from each of the 17 replacement boring locations. The data show the presence of a wide variety of chemical contaminants at high concentrations across the site. Volatile organic compounds, base/neutral compounds, acid extractable compounds, pesticides, PCBs, cyanides and petroleum hydrocarbons were present in soils at all strata sampled. In addition, inorganic contaminants were detected at high levels across the site.

Figures 12 through 23 show the occurrence, distribution and total concentrations of volatile organics, base/neutrals, acid extractables, pesticides, PCBs, total cyanides, total phenolics and total

petroleum hydrocarbons detected in subsurface soil at the 0 to 2 feet (unsaturated fill), 5 to 6 feet (saturated fill), and top of clay (upper one foot) sampling intervals. The occurrence of the following metals are also shown on these figures: antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver and zinc. The analytical data for the environmental samples collected during drilling of the 17 replacement borings have been incorporated in Appendix B, in two formats. The first set of data summaries lists analytical data versus depth for each boring. The second set of data summaries is a reorganization of the first data set and lists the analytical data by stratum (unsaturated fill, saturated fill, top foot of clay, and within the clay).

Table 6 describes the occurrence, concentration ranges, mean and standard deviation of volatile organics, base/neutrals, acid extractables, pesticides, PCBs, total cyanides, total phenolics, total petroleum hydrocarbons and metals detected in soil samples collected on site. Where there is a wide variability in the data, the standard deviation is not a useful parameter for evaluating data. A more detailed discussion of each chemical class follows.

4.2.3.1 Volatile Organic Compounds

As indicated on Table 6, the most prevalent (detected in more than half of the samples) volatile organic compounds (VOCs) at the site include methylene chloride, tetrachloroethylene, toluene, trichloroethylene and xylenes. Other prevalent VOCs include benzene, chlorobenzene, chloroform, 1,2-dichloroethane, ethylbenzene, 1,2-trans-dichloroethylene, 1,1,1-trichloroethane, and methyl ethyl ketone. There is no apparent trend to the horizontal distribution of the VOCs, as discussed in the following paragraphs.

Figure 12 shows the horizontal distribution of VOCs in the unsaturated fill. This figure indicates that the highest total VOC concentration occurs at boring RB-1 (sludge pit). The compounds detected in this sample include: benzene (53.9 mg/kg), chlorobenzene (336 mg/kg), 1,1 dichloroethane (64.7 mg/kg), ethylbenzene (652 mg/kg), tetrachloroethylene (2170 mg/kg), toluene (3380 mg/kg), trichloroethylene (2060 mg/kg) and xylenes (3450 mg/kg). Except for tetrachloroethylene, these were the highest values for these compounds in the unsaturated fill. The highest concentrations in the unsaturated fill of the other VOCs include: 4,290 mg/kg of tetrachloroethylene at boring RB-2; 8.56 mg/kg of methyl ethyl ketone at boring RMW-2D; 47.3 mg/kg of chloroform at boring RB-5; and 23.2 mg/kg of 1,2-dichloroethane at boring RB-5. In the unsaturated fill, VOCs are detected at low concentrations (less than 1 mg/kg) at borings RMW-1S, RP-3 and RP-4. In borings RP-1, RB-6, RMW-7D, RMW-4S, RMW-5D and RMW-6S, the VOCs are less than 10 mg/kg. The VOCs are greater than 100 mg/kg in the remaining borings.

Figure 16 shows the horizontal distribution of VOCs in the saturated fill. This figure indicates that the highest total VOC concentration occurs at boring RMW-7D (9,889.8 mg/kg, or almost 1 percent), although levels greater than 2,000 mg/kg are also found at borings RB-1, RB-2, RB-3, RB-5 and RMW-3S. The compounds detected in the sample from RMW-7D include: benzene (52.3 mg/kg), chlorobenzene (258 mg/kg), 1,1-dichloroethane (43.1 mg/kg), ethylbenzene (529 mg/kg), tetrachloroethylene (1,440 mg/kg), toluene (2,270 mg/kg), 1,2-trans-dichloroethylene (512 mg/kg), 1,1,1-trichloroethane (30.4 mg/kg), trichloroethylene (1,670 mg/kg), methyl ethyl ketone (795 mg/kg) and xylenes (2,290 mg/kg). Except for four of the compounds (1,2-dichloroethane, tetrachloroethylene, toluene, and 1,1,1-trichloroethane), the values in the RMW-7D sample represent the highest concentrations of the VOC compounds in the saturated fill. The highest concentrations of other VOCs in the saturated fill include: 379 mg/kg of chloroform at RMW-3S; 14.9 mg/kg of methylene chloride at RMW-4S; 672 mg/kg of 1,1,2-trichloroethane at RB-1; 1,690 mg/kg of

tetrachloroethylene at RB-2; and 179 mg/kg of 1,1-dichloroethane, 290 mg/kg of 1,2-dichloroethane, 2,410 mg/kg of toluene, and 1,770 mg/kg of 1,1,1-trichloroethane, all at boring RB-3. In borings RP-4, RMW-2D and RMW-6S, the VOCs were less than 10 mg/kg. VOCs were not detected in boring RMW-1S.

Figure 20 shows the horizontal distribution of VOCs in the top of the clay stratum. The highest VOC concentration occurred at boring RP-4. The compounds detected in this sample include: ethylbenzene (45.6 mg/kg), methylene chloride (20.8 mg/kg), tetrachloroethylene (917 mg/kg), toluene (216 mg/kg), 1,1,1-trichloroethane (57.6 mg/kg), trichloroethylene (363 mg/kg) and xylenes (223 mg/kg). These were the peak values for these compounds at this sampling interval. Other peak concentrations include: 234 mg/kg of chloroform at RMW-3S; 12.2 mg/kg of 1,2-trans-dichloroethylene at RMW-3S; and 31.5 mg/kg of methyl ethyl ketone at RMW-7D. VOCs were not detected in borings RP-1 and RB-4, were detected at very low levels (less than 1 mg/kg) in borings RMW-1S and RMW-4S, and were less than 10 mg/kg in borings RMW-2D, RMW-5D, RB-1, RB-3 and RB-6.

No clear pattern is evident in the horizontal distribution of VOCs at each of the intervals described above.

Within the unsaturated and saturated fill, no clear pattern is evident in the vertical distribution of VOCs. However, most borings indicate decreasing VOCs at the top of clay and below. Only boring RMW-1S maintains consistently low VOC concentrations from the ground surface through the fill to the top of the clay stratum. Three borings indicate decreasing concentrations of VOCs with depth: RB-1, RB-2 and RB-4. Ten borings have VOC concentrations that are highest in the saturated fill: RB-3, RB-5, RB-6, RP-1, RP-2, RP-3, RMW-3S, RMW-4S, RMW-5D and RMW-7D (this comparison excludes, at this point, samples from within the clay). Two borings have their lowest VOC concentration in the saturated fill: RMW-2D and RMW-6S. The samples from boring RP-4 exhibit

increasing concentrations of VOCs with depth, to the top of clay. Table 7 includes a summary of each stratum, and substantiates the above discussion. Tables 7A through 7D provide a breakdown by compound in each stratum. As shown in Table 7, the mean VOC concentration nearly doubles from the unsaturated fill to the saturated fill, and then decreases substantially at the top of the clay stratum. For example, decreases in concentration of VOCs from saturated fill VOCs to top of clay include the following: 6,502 mg/kg to 7.3 mg/kg at boring RB-1; 9,890 mg/kg to 35 mg/kg at boring RMW-7D; 2,052 mg/kg to 15 mg/kg at boring RB-5; 3,394 mg/kg to 32 mg/kg at boring RB-2; 2,102 mg/kg to 66 mg/kg at boring RMW-3S; and 8,418 mg/kg to 16.7 mg/kg at boring RB-3. Boring RP-4 is the only boring that indicated a substantial increase in VOC concentration from the saturated fill to the top of clay: 0.841 mg/kg to 1,822 mg/kg.

Within the clay, samples were collected from three borings: RMW-2D, RMW-5D and RMW-7D. The vertical distribution of VOCs within the clay is depicted on Figure 24, which also include VOC concentrations above the clay from the same three borings. The VOCs detected within the clay in boring RMW-2D, along with the maximum concentrations of each, were: chloroform (333 mg/kg), 1,2-dichloroethane (69.9 mg/kg), methylene chloride (10.1 mg/kg), and trichloroethylene (26.2 mg/kg). These four compounds were detected in both samples from within the clay at RMW-2D; no other VOCs were detected.

In boring RMW-5D, the predominant VOCs within the clay included the following compounds and their maximum concentrations: trichloroethylene (142 mg/kg), tetrachloroethylene (37.8 mg/kg), methylene chloride (44.4 mg/kg), toluene (24.5 mg/kg) and xylenes (18.8 mg/kg). These five compounds were detected in all four samples from within the clay at this boring. Other VOCs detected included chloroform in 3 samples, and the following compounds at the clay/till interface: chlorobenzene, 1,1-dichloroethane, 1,2-dichloroethane, 1,1,1-trichloroethane and methyl ethyl ketone.

The predominant VOCs within the clay at boring RMW-7D included the following compounds and their maximum concentrations: trichloroethylene (1,560 mg/kg), tetrachloroethylene (785 mg/kg), toluene (715 mg/kg), xylenes (460 mg/kg) and methylene chloride (124 mg/kg). Other compounds included: chlorobenzene, ethylbenzene, 1,2-trans-dichloroethylene, 1,1,1-trichloroethane and methyl ethyl ketone, all of which were detected primarily in the upper part of the clay.

Figure 24 illustrates the vertical VOC distribution in the clay. No consistent pattern is evident at boring RMW-2D. In fact, the highest concentration of VOCs at this boring is found within the clay, after a decrease in the saturated fill. At boring RMW-5D, the total VOC concentration increases by three orders of magnitude from the top of the clay to within the clay, followed by a slight decrease in total VOC concentration at the base of the clay. At boring RMW-7D, a significant increase in VOC concentration from the top of clay to within the clay is again evident. However, in this boring the attenuation of VOC concentrations is substantial after the initial increase. This is likely due to the increased thickness of the clay layer present in the area of this boring. Note that where the clay is thinner (RMW-2D and RMW-5D), no such attenuation is evident. In addition, at a depth of approximately 20 feet from grade in the three borings, the VOC concentrations are within the same order of magnitude. This further indicates that the VOC attenuation observed at boring RMW-7D is related to the clay thickness.

In summary, volatile organic compounds were widespread across the site and throughout the unsaturated and saturated fill. The concentrations were substantially reduced (the mean concentrations were more than an order of magnitude lower) at the top of the clay and within the clay, with two exceptions: the top of the clay sample from boring RP-4 had an increased concentration, and the sample collected from two feet into the nearly 30-foot thick clay layer at boring RMW-7D also had an increased concentration that did, however, rapidly attenuate with depth in the clay. The data collected demonstrate that VOCs have

migrated from the fill into the clay layer; the substances found in the clay are also found in the unsaturated and saturated fill, usually at higher concentrations. It must be recognized that extremely high levels of VOCs exist in soils across the site in all strata sampled, and while concentrations were generally lower in the clay, VOCs exist in the clay at levels exceeding 200 mg/kg.

4.2.3.2 Base/Neutral Compounds

As shown on Table 6, the most prevalent (detected in more than half the samples) base/neutral compounds (B/NCs) at the site include bis (2-ethylhexyl) phthalate, fluoranthene, naphthalene and pyrene. Other prevalent (10 or more occurrences) B/NCs include 10 polynuclear aromatic hydrocarbons, 3 phthalates, and 1 chlorinated hydrocarbon. As with VOCs, there is no apparent trend to the horizontal distribution of the B/NCs.

Figure 12 shows the horizontal distribution of B/NCs in the unsaturated fill. This figure indicates that the highest B/NC concentration (447 mg/kg) occurs at boring RB-1 (sludge pit). The primary B/NCs detected in this sample include: 2-chloronaphthalene (122 mg/kg), 1,2-dichlorobenzene (47.3 mg/kg), bis(2-ethylhexyl)phthalate (162 mg/kg), fluoranthene (2.42 mg/kg), naphthalene (102 mg/kg) and phenanthrene (9.41 mg/kg). The concentrations listed for the first two compounds were the highest values detected in the unsaturated fill. The highest concentrations of other B/NCs in the unsaturated fill include: 281 mg/kg of bis (2-ethylhexyl) phthalate at boring RB-3; 86.1 mg/kg of butyl benzyl phthalate at boring RMW-3S; 71 mg/kg of di-n-butyl phthalate at boring RB-3; 11 mg/kg of fluorene at boring RMW-5D; 117 mg/kg of nitrobenzene at boring RMW-3S; 23.6 mg/kg of phenanthrene at boring RMW-5D; 10.5 mg/kg of naphthalene at boring RP-2; and 15.3 mg/kg of fluoranthene, 17.7 mg/kg of benzo(b)fluoranthene, 12.1 mg/kg of ideno(1,2,3-c,d)pyrene, and 12.7 mg/kg of pyrene, all at boring RP-1. The B/NCs are widespread throughout the unsaturated fill.

Figure 16 shows the horizontal distribution of B/NCs in the saturated fill. This figure indicates that the highest B/NC concentration (3,912.8 mg/kg) occurs at boring RMW-3S. The primary compounds detected in this sample include: acenaphthene (21.2 mg/kg), acenaphthylene (21.0 mg/kg), anthracene (86.3 mg/kg), benzo(a)anthracene (84.2 mg/kg), benzo(a)pyrene (108 mg/kg), benzo(b)fluoranthene (164 mg/kg), benzo(ghi)perylene (73.3 mg/kg), butyl benzyl phthalate (73.6 mg/kg), chrysene (106 mg/kg), 1,2-dichlorobenzene (385 mg/kg), di-n-butyl phthalate (98.2 mg/kg), fluoranthene (176 mg/kg), fluorene (94.1 mg/kg), ideno(1,2,3-c,d)pyrene (86.9 mg/kg), naphthalene (480 mg/kg), nitrobenzene (1,350 mg/kg), phenanthrene (268 mg/kg), pyrene (118 mg/kg), and bis(2-ethylhexyl)phthalate (119 mg/kg). Except for the last compound, all values in the RMW-3S sample represent the highest concentrations of the compounds in the saturated fill. Other highest concentrations include: 381 mg/kg of bis(2-ethylhexyl)phthalate at boring RMW-2D, 19.5 mg/kg of di-n-octyl phthalate at boring RMW-2D, 244 mg/kg of benzidine at boring RB-1, and 18.2 mg/kg of 2-chloronaphthalene at boring RB-1. The BN/Cs were not detected in the saturated fill at boring RMW-5D, and the concentrations were less than 50 mg/kg at boring RP-1, RP-2, RP-3, RP-4, RB-4, RMW-1S, RMW-6S, and RMW-7D.

Figure 20 shows the horizontal distribution of B/NCs in the top of clay. The highest concentration (174.3 mg/kg) occurs at boring RP-4. The primary compounds detected in this sample include: bis(2-ethylhexyl)phthalate (21.6 mg/kg), 1,2-dichlorobenzene (10.8 mg/kg), and nitrobenzene (135 mg/kg). The highest concentration of bis(2-ethylhexyl)phthalate, however, occurred at RB-5 (33.6 mg/kg). None of the remaining 15 samples exhibited total B/NC concentrations greater than 50 mg/kg.

The vertical distribution of B/NCs within the fill exhibits an overall trend of decreasing concentrations with depth: most (14 of 17) borings indicate decreasing B/NCs at the top of the clay and below. Half the borings indicate a consistent decrease of B/NC concentrations with

depth: RB-1, RB-2, RB-3, RB-4, RP-2, RP-3, RMW-1S, RMW-4S and RMW-6S. Five borings have B/NC concentrations that are highest in the saturated fill: RB-5, RB-6, RMW-2D, RMW-3S and RMW-7D. Two borings have their lowest B/NC concentrations in the saturated fill: RP-1 and RMW-5D. The samples from boring RP-4 exhibit increasing concentrations of B/NCs with depth, to the top of clay. Table 8 includes a summary of each stratum, and indicates the overall trend is decreasing B/NC concentrations with increasing depth (with the exceptions noted on the table and discussed above). Tables 8A through 8D provide a breakdown by compound in each stratum.

Within the clay, B/NCs (where detected) were present at low levels (less than 2 mg/kg). At boring RMW-2D, no B/NCs were detected within the clay. At boring RMW-5D, B/NCs were detected in both samples: 0.511 mg/kg and 1.183 mg/kg of total B/NCs. The compounds present in the first sample were nitrobenzene, isophorone, and 1,2-dichlorobenzene. The compounds present in the second sample were nitrobenzene and 1,2-dichlorobenzene. At boring RMW-7D, B/NCs were detected in all three samples: 0.170 mg/kg, 0.313 mg/kg, and 0.146 mg/kg (listed in order of increasing depth). The only compound detected in any of the three samples at this location was nitrobenzene.

Note that, with the exception of isophorone, the compounds detected in the clay were also detected in the saturated and unsaturated fill, and at the top of the clay, indicating downward migration of these contaminants through the fill unit into the clay. This is supported by Table 3, which shows that these compounds are mobile.

In summary, base/neutral compounds are widespread across the site and throughout the unsaturated and saturated fill. The concentrations were substantially reduced at the top of clay and within the clay, with one exception: the top of clay sample from boring RP-4 had an increased concentration.

4.2.3.3 Acid Extractable Compounds

With the exception of phenol, acid extractable compounds (AECs) were not very prevalent at the site, as indicated in Table 6. The two samples exhibiting the highest levels of phenol were:

- o 58.2 mg/kg phenol, boring RB-1, unsaturated fill
- o 790.0 mg/kg phenol, boring RB-1, saturated fill

Other concentrations above 10 mg/kg included:

- o 10.8 mg/kg 2,4-dimethylphenol, boring RB-1, saturated fill
- o 35.2 mg/kg phenol, boring RMW-7D, saturated fill
- o 14.4 mg/kg phenol, boring RP-4, top of clay

The elevated levels of AECs in boring RB-1 are believed to be related to the sludge pit at that location.

Within the clay, AECs were detected in two of seven samples: 0.238 mg/kg of 2-chlorophenol at boring RMW-5D, and 0.434 mg/kg of phenol at boring RMW-7D. Note that phenol was the most prevalent AEC detected in the saturated and unsaturated fill.

A review of Figures 12, 16 and 20 indicates that the higher AEC concentrations occur in the northeast corner of the site, clustered around borings RB-1, RP-4 and RMW-7D.

The vertical distribution of AECs is shown on Table 9. With the sludge sample from boring RB-1 excluded, the mean concentrations of AECs tend to decrease with depth. Boring RP-4 is, again, an exception: the AEC concentrations increase with depth to the top of clay. Within the clay, lower levels of AECs were detected. Table 9A provides a breakdown by compound in each stratum. The presence of phenol at all four depths sampled indicates that this compound is migrating from the fill into the clay. As shown in Table 3, phenol is considered a very mobile compound.

4.2.3.4 Pesticide Compounds

With the exception of dieldrin, pesticide compounds were not as prevalent at the site as many of the other classes of compounds discussed, as indicated by Table 6. The three highest levels detected were as follows:

- o 57 mg/kg dieldrin, boring RB-6, unsaturated fill
- o 57 mg/kg aldrin, boring RB-6, unsaturated fill
- o 150 mg/kg methoxychlor, boring RP-4, saturated fill

The levels then decrease substantially to the next highest levels:

- o 2.3 mg/kg dieldrin, boring RP-1, unsaturated fill
- o 1.2 mg/kg aldrin, boring RB-6, saturated fill.

A review of Figures 13, 17 and 21 indicates that pesticides occur primarily in borings RP-1, RP-4 and RB-6, all on the eastern side of the site. The vertical distribution of pesticides (excluding methoxychlor, which was detected in only one sample, listed above) is shown on Table 10. The concentrations for both compounds decrease with increasing depth. No pesticides were detected within the clay. Most pesticides are generally less mobile than the other classes of compounds, and therefore, it is logical that pesticides have not been detected in the clay, while other compounds have demonstrated such migration.

4.2.3.5 PCBs

As indicated on Table 6, the most prevalent PCB at the site was quantified as Aroclor 1242. It was detected in 36 of the 58 samples collected. Other PCBs detected at the site were quantified as Aroclors 1248 (8 samples), 1254 (9 samples) and 1260 (6 samples).

Figure 14 illustrates the horizontal distribution of PCBs in the unsaturated fill. The highest PCB concentration occurs at boring RB-1 (sludge pit), where 15,000 mg/kg of PCB quantified as Aroclor 1242 was detected. This value, however, is not typical of the PCB concentrations in the unsaturated fill. Beside the RB-1 sample, five other samples in the unsaturated fill exhibited PCB concentrations greater than 25 mg/kg: 400 mg/kg at boring RMW-3S, 96 mg/kg at RP-2, 52.4 mg/kg at boring RMW-6S, 46.4 mg/kg at boring RMW-2D, and 32.9 mg/kg at boring RB-2. PCBs were not detected at two borings, RP-3 and RB-6.

Figure 18 illustrates the horizontal distribution of PCBs in the saturated fill. The highest PCB concentration occurs at boring RMW-2D, where 350 mg/kg of PCB quantified as Aroclor 1242 was detected. Beside RMW-2D, two other locations had PCB concentrations in excess of 25 mg/kg: 210 mg/kg at boring RB-1 (sludge pit), and 290 mg/kg at boring RMW-3S. PCBs were not detected at two borings, RP-3 and RB-4.

Figure 22 illustrates the horizontal distribution of PCBs in the top of clay. The highest PCB concentration occurs at boring RMW-3S, where 5.4 mg/kg of PCB quantified as Aroclor 1242 was detected. PCB was not detected in borings RP-1, RB-4, RMW-1S and RMW-2D.

Within the clay, PCB quantified as Aroclor 1242 was detected in the three samples from boring RMW-7D. In order of increasing sample depth, these concentrations were: 0.370 mg/kg, 0.110 mg/kg, and 0.082 mg/kg. PCB was not detected in the four samples from RMW-2D and RMW-5D.

The vertical distribution of PCBs within the fill exhibits an overall trend of decreasing concentrations with depth: 12 of the 16 borings in which PCBs were detected in the fill had a decrease in concentration from the unsaturated fill samples to the saturated fill samples. These borings were: RP-1, RP-2, RB-1, RB-2, RB-4, RB-5, RMW-1S, RMW-3S, RMW-4S, RMW-6S, RMW-5D and RMW-7D. Of these, only RMW-5D exhibited an increase in PCB concentration at the top of clay, although

both values were less than 1 mg/kg (0.080 mg/kg in the saturated fill, and 0.244 mg/kg in the top of clay). Of the four borings that exhibited increasing PCB concentrations in the fill (RP-4, RB-3, RB-6 and RMW-2D), only boring RP-4 exhibited a continuing increase in PCB concentration to the top of clay, but the level at the top of clay was only 2.1 mg/kg. The remaining three borings exhibited a decrease in PCB concentration at the top of clay, to less than 1 mg/kg. An unusual vertical distribution was exhibited at boring RP-3, where PCBs were not detected in either fill sample but was detected at 5 mg/kg in the top of clay.

Table 11 indicates the vertical PCB distribution by stratum. While there is no significant change in the mean values in the fill, it is worth noting that the mean value in the saturated fill primarily reflects the PCB concentrations at three locations (RB-1, RMW-2D, RMW-3S, which themselves have a mean of 283 mg/kg). Excluding the contribution of these three samples, the mean concentration in the saturated fill is 6.7 mg/kg. This substantiates the previously-discussed tendency of decreasing PCB concentrations with increasing depth. With these samples included, the trend still holds true to the top of clay and within the clay. Table 11A provides a breakdown by compound in each stratum.

In summary, PCBs are widespread in the unsaturated fill, less so in the saturated fill, present at lower concentrations in the top of clay, and are present at very low levels within the clay. As indicated in Table 3, PCBs are not expected to be mobile; however, the presence of solvents in the soils and ground water of the site may contribute to the mobility of PCBs. This may explain why PCBs are found at all depths sampled.

4.2.3.6 Total Cyanides

Total cyanides were detected in almost half of the 58 soil samples collected (see Table 6). The concentrations were generally lower than those of other contaminants found at the site. The detections above 10 mg/kg were:

- o 13.3 mg/kg, boring RMW-3S, unsaturated fill
- o 34 mg/kg, boring RMW-5D, unsaturated fill
- o 32 mg/kg, boring RMW-3S, saturated fill
- o 17.7 mg/kg, boring RMW-7D, saturated fill

The horizontal distribution of total cyanides is illustrated on Figures 13, 17 and 21. The vertical distribution of total cyanides, as indicated on Table 12, yields no real pattern. Total cyanides were prevalent in the unsaturated fill, less so in the saturated fill, and present in only one sample at the top of clay: 3.5 mg/kg in boring RP-4. None was detected within the clay.

4.2.3.7 Total Phenolics

Total phenolics were detected in 48 of the 58 soil samples collected (see Table 6). The two highest concentrations occurred in the sludge pit samples from boring RB-1: 600 mg/kg in the unsaturated fill, and 683 mg/kg in the saturated fill.

Figure 13 illustrates the horizontal distribution of total phenolics in the unsaturated fill. Beside borings RB-1 (600 mg/kg) and RMW-5D (75 mg/kg), no phenolics were detected at a level above 50 mg/kg. In five other borings, total phenolics were detected at levels above 10 mg/kg in the unsaturated fill: RP-2, RB-4, RB-5, RB-6 and RMW-4S.

In the saturated fill (Figure 17), other than boring RB-1 (683 mg/kg), only two samples had total phenolics above 50 mg/kg: RMW-3S (123 mg/kg) and RMW-7D (55 mg/kg). In five other borings, total phenolics were detected at levels above 10 mg/kg in the saturated fill: RP-2, RP-3, RB-3, RB-5 and RMW-4S.

In the top of clay (Figure 21), the highest total phenolics concentration was found at boring RP-4 (65 mg/kg). Only one other sample had a concentration greater than 10 mg/kg: boring RB-3 (12 mg/kg). Nine

samples had concentrations equal to or less than 2 mg/kg in the top of clay.

Within the clay, total phenolics were detected in three of the seven samples, all with concentrations less than 2 mg/kg: 1.4 mg/kg and 1.6 mg/kg at boring RMW-5D, and 1.4 mg/kg at boring RMW-7D.

Table 13 shows the vertical distribution of total phenolics. While no trend exists within the fill, the concentrations generally decrease at the top of clay and below. The one noteworthy exception occurs at boring RP-4, where concentrations increase with depth to the top of clay, as shown below:

- o 0.6 mg/kg in the unsaturated fill
- o 7.5 mg/kg in the saturated fill
- o 65 mg/kg in the top of clay

The presence of phenolics within the clay indicates that these substances have migrated from the fill unit.

4.2.3.8 Total Petroleum Hydrocarbons

Total petroleum hydrocarbons (PHC) were detected at extremely high levels in almost all soil samples (see Table 6). The samples with PHC concentrations in excess of 10,000 mg/kg (1 percent) were the following:

- o 81,600 mg/kg, boring RB-1, unsaturated fill
- o 13,700 mg/kg, boring RB-2, unsaturated fill
- o 11,800 mg/kg, boring RMW-3S, unsaturated fill
- o 78,000 mg/kg, boring RMW-5D, unsaturated fill

- o 27,500 mg/kg, boring RB-1, saturated fill
- o 10,400 mg/kg, boring RB-2, saturated fill

- o 13,600 mg/kg, boring RB-3, saturated fill
- o 10,900 mg/kg, boring RB-5, saturated fill
- o 29,600 mg/kg, boring RB-6, saturated fill
- o 16,500 mg/kg, boring RMW-3S saturated fill
- o 14,000 mg/kg, boring RMW-4S, saturated fill

In the unsaturated fill (Figure 13), PHCs are widespread. Only five samples had PHC concentrations less than 1,000 mg/kg: RP-4, RB-4, RB-6, RMW-1S, and RMW-4S. The same holds true in the saturated fill, where again only five samples had PHC concentrations less than 1,000 mg/kg: RP-1, RP-2, RP-4, RMW-1S and RMW-6S (Figure 17). In the top of clay, however, the pattern is reversed (Figure 21). Only four samples had PHC concentrations in excess of 1,000 mg/kg: RP-3 (3,780 mg/kg), RB-2 (1,010 mg/kg), RB-3 (5,780 mg/kg), and RMW-4S (4,650 mg/kg). Within the clay, PHC was detected in four of the seven samples; however, the highest concentration was only 102 mg/kg in RMW-2D.

Table 14 shows the vertical distribution of PHCs. While a comparison of Figures 13 and 17 indicates that nine borings have increasing PHC concentrations in the fill, the mean concentration decreases from 13,167 mg/kg in the unsaturated fill to 8,507 mg/kg in the saturated fill. From the saturated fill to the top of clay, only two borings show increasing PHC concentrations: RP-3 and RMW-1S. The remaining 15 borings exhibit decreasing concentrations to the top of clay, and this is reflected in the decrease in the mean concentration from 8,507 mg/kg in the saturated fill to 1,164 mg/kg in the top of clay. This trend continues within the clay, which has a mean PHC concentration of 82.5 mg/kg.

In summary, total petroleum hydrocarbons are widespread at extremely high levels (percentage levels) within the fill. However, the concentrations decrease at the top of and within the clay. The presence of these substances indicates vertical distribution and migration from the unsaturated fill down into the clay.

4.2.3.9 Metals

Twelve metals (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver and zinc) were detected in the borings at all three sampling intervals to the top of clay. The metals were widespread across the site within the fill and in the top of clay. A comparison of Figures 15 (unsaturated fill), 19 (saturated fill) and 23 (top of clay) illustrates this point. However, there is a general trend of decreasing concentrations with increasing depth; this is demonstrated in Table 15, which correlates mean concentrations of each metal with the four strata sampled. Exceptions to this general trend exist, and are discussed in the following paragraphs.

Copper and zinc were detected (above method detection limits) in all 58 soil samples tested for metals. In the unsaturated fill, the copper concentrations ranged from 265 mg/kg (boring RMW-5D) to 71,600 mg/kg (boring RB-5). In the saturated fill, the copper concentrations ranged from 32 mg/kg (boring RMW-5D) to 8,600 mg/kg (boring RB-1). In the top of clay samples, the copper concentrations ranged from 11 mg/kg (RB-4) to 11,900 mg/kg (RB-1). The general trend is decreasing copper concentrations with increasing depth, with the exception of RP-3 and RMW-2D (where the concentration increases in the saturated fill and then decreases at the top of clay), and RB-1 (where the concentration increases at the top of clay). The general decrease in concentrations from the saturated fill to the top of clay is substantial (except at RB-1, as previously noted). Within the clay, the copper concentrations ranged from 15 mg/kg to 38 mg/kg, which is comparable to the lowest concentrations in the top of clay samples.

The range of zinc concentrations in the unsaturated fill was 130 mg/kg (RMW-2D) to 4,170 mg/kg (RB-1). In the saturated fill, zinc concentrations ranged from 46 mg/kg (RP-1) to 1,870 mg/kg (RB-6). At the top of clay, zinc concentrations ranged from 22 mg/kg (RP-1) to 44,400

mg/kg (RP-3). There is no trend with respect to zinc when comparing the unsaturated fill with saturated fill; zinc concentrations decrease in about half the samples, and increase in the other half. However, with one exception, the zinc concentrations decrease substantially from the saturated fill to the top of clay. The exception is at boring RP-3, where the zinc concentration increases consistently with depth: 442 mg/kg in the unsaturated fill, 1,400 mg/kg in the saturated fill, and 44,400 mg/kg at the top of clay. Within the clay, the zinc concentrations ranged from 42 mg/kg to 87 mg/kg, which is consistent with the range exhibited in the top of clay samples when the RP-3 data are excluded.

Cadmium was detected in 43 of the 58 soil samples. In the unsaturated fill, the range for cadmium was 1 mg/kg (RP-4) to 95.1 mg/kg (RB-1). In the saturated fill, the range for concentrations above the method detection limit (MDL) was 0.32 mg/kg (RB-4) to 22 mg/kg (RB-3). Cadmium was below the MDL at RP-1. At the top of clay, cadmium was detected in only eight of the seventeen locations, with a range of 0.56 mg/kg (RMW-5D) to 132 mg/kg (RB-1). As with zinc, no clear trend exists with respect to cadmium concentrations when comparing the unsaturated fill with the saturated fill; there are decreases at some locations and increases at other. The cadmium concentrations in the top of clay, however, are, in general, substantially reduced when compared with the saturated fill. Exceptions occur at RP-3 and RB-1, where cadmium concentrations increase at the top of clay. In addition, RB-1 consistently exhibits increasing concentrations with increasing depth: 25 mg/kg in the unsaturated fill, 95.1 mg/kg in the saturated fill, and 132 mg/kg at the top of clay. Within the clay, cadmium was only detected (above the MDL) in one of seven samples, at 0.28 mg/kg in RMW-2D.

Mercury was detected in 42 of the 58 soil samples. In the unsaturated fill, the concentrations ranged from 0.4 mg/kg (RMW-2D) to 21.3 mg/kg (RB-6). In the saturated fill, the concentrations ranged from 0.14 mg/kg (RMW-5D and RB-2) to 13.6 mg/kg (RB-2). Mercury was not

detected above the MDL at RMW-1S at this depth. At the top of clay, mercury was detected above the MDL at nine of the seventeen locations, with concentrations ranging from 0.084 mg/kg (RMW-1S) to 13.6 mg/kg (RP-3). With the exception of the value at RP-3, the concentrations in the remaining eight samples were less than 1 mg/kg. Mercury was not detected above the MDL within the clay. The vertical distribution within the fill indicates unchanged or decreasing concentrations of mercury from unsaturated fill to the saturated fill, except at RB-5 where the concentration increased from 0.64 mg/kg to 2.7 mg/kg. From the saturated fill to the top of clay, concentrations of less than 1 mg/kg remained unchanged, while the higher concentrations decrease substantially to less than 1 mg/kg. Again, RP-3 is the exception, where the concentration increased at the top of clay.

The three highest arsenic concentrations were as follows:

- o 60 mg/kg, RMW-5, unsaturated fill.
- o 62 mg/kg, RMW-4S, saturated fill.
- o 51 mg/kg, RMW-7D, saturated fill.

No clear trend in vertical arsenic distribution is observed in the fill. From the saturated fill to the top of clay, there is a significant decrease in arsenic concentrations, with the exception of RB-2 and RB-1 where the values increase from below the MDL to 4.3 mg/kg, and from 8.8 mg/kg to 14 mg/kg, respectively. Within the clay, arsenic was detected above the MDL in five of seven samples, with concentrations ranging from 1.1 to 5.5 mg/kg (both values from samples in RMW-7D).

Beryllium exceeded 50 mg/kg in only one sample: 57.6 mg/kg at the top of clay sample from boring RMW-5D. The next highest concentration was 1.3 mg/kg in the saturated fill sample from boring RP-1. Within the clay, beryllium concentrations ranged from 0.59 mg/kg (RMW-2D) to 1.2 mg/kg (RMW-2D and RMW-7D).

The three highest chromium concentrations were as follows:

- o 870 mg/kg, RP-3, unsaturated fill.
- o 721 mg/kg, RB-1, unsaturated fill.
- o 542 mg/kg, RB-1, saturated fill.

Chromium concentrations decreased at most locations with depth to the top of clay. Exceptions include: RMW-3S, where the concentrations increased from 100 mg/kg in the unsaturated fill to 255 mg/kg in the saturated fill, before decreasing to 24 mg/kg at the top of clay; RB-5, where the concentrations increased from 57 mg/kg in the unsaturated fill to 166 mg/kg in the saturated fill, before decreasing to 28 mg/kg at the top of clay; and RMW-7D, where the concentrations increased from 39 mg/kg in the unsaturated fill to 72 mg/kg in the saturated fill, before decreasing to 17 mg/kg at the top of clay. The chromium concentrations at the top of clay ranged from 13 mg/kg (RP-1) to 56 mg/kg (RP-3). The chromium concentrations within the clay ranged from 17 mg/kg (RMW-2D) to 33 mg/kg (RMW-2D, -5D, and -7D).

The three highest lead concentrations were as follows:

- o 2,750 mg/kg, RB-1, unsaturated fill.
- o 2,110 mg/kg, RB-1, saturated fill.
- o 2,810 mg/kg, RP-3, saturated fill.

Most of the remaining concentrations were below 1,000 mg/kg. Except for four locations, the lead concentrations decreased from the unsaturated fill to the saturated fill; in many cases, the decreases were substantial. The four exceptions include increasing concentrations at RB-3 (410 mg/kg to 520 mg/kg), RMW-3S (400 mg/kg to 1,490 mg/kg), RMW-2D (140 mg/kg to 230 mg/kg), and RB-6 (880 mg/kg to 1,680 mg/kg). However, all lead concentrations decreased at the top of clay. The most dramatic decreases from the saturated fill to the top of clay occurred at the following locations: RB-1 (2,110 mg/kg to 170 mg/kg), RB-5 (1,340 mg/kg

to 180 mg/kg), RB-6 (1,680 mg/kg to 120 mg/kg), and RP-3 (2,810 mg/kg to 916 mg/kg). At all other locations, the top of clay concentrations decreased to less than 100 mg/kg. Within the clay, lead was detected above the MDL in six of the seven samples. The concentrations ranged from 9.6 mg/kg (RMW-7D) to 15 mg/kg (also at RMW-7D).

The highest nickel concentration, 116 mg/kg, occurred at RMW-4S in the saturated fill. All other samples had nickel concentrations less than 100 mg/kg. Other than RMW-4S, no pattern was evident in the vertical distribution of nickel. The nickel concentrations within the clay were consistent with those in the overlying fill.

The three least prevalent metals include: antimony (8 occurrences, range of 6.9 mg/kg to 38 mg/kg); selenium (9 occurrences, range of 0.88 mg/kg to 4.9 mg/kg); and silver (9 occurrences, range of 1.2 mg/kg to 40 mg/kg). No trend in horizontal distribution of the three metals is evident, and only silver exhibits a trend in vertical distribution. At boring RB-1, silver was detected in all three samples to the top of clay; otherwise, silver was detected above MDLs only in the unsaturated fill. None of these three metals was detected within the clay.

The overall trend of the vertical distribution of metals, while not particularly well-established in the fill, indicates that at most boring locations the concentrations decrease to lower values at the top of clay and within the clay. Exceptions are boring RB-1 (where copper, cadmium and arsenic concentrations increase at the top of clay) and boring RP-3 (where zinc, cadmium and mercury concentrations increase at the top of clay). This decrease in concentration with depth supports the conclusion that metals are migrating from the shallow fill deeper down through the fill and into the clay.

4.2.3.10 Soil Quality: Conclusions

A wide array of organic and inorganic chemical contaminants were detected in the site soils. The prevalent compounds include volatile organic compounds, base/neutral compounds, PCBs, phenolics, petroleum hydrocarbons and metals. Acid extractable compounds, pesticides and cyanides were present to a lesser extent.

These organic and inorganic chemical compounds detected were widespread at high concentrations in both the unsaturated fill and saturated fill, although in many cases the concentrations decreased in the saturated fill. Most were detected at substantially lower concentrations in the top of clay, and exhibited even greater attenuation within the clay. This concentration gradient (trend towards decreasing concentrations with depth) supports the conclusion that the fill acts as a source for contaminant migration downwards into the clay layer at the site. Volatile organic compounds did not generally show attenuation within the clay; these compounds attenuated sharply in only one boring (RMW-7D), where the clay is thickest. This indicates that the most mobile compounds (volatile organics) tend to migrate into and, as discussed in Section 4.3.3.2, through the clay, while the less mobile compounds (i.e. metals) have not yet shown such a tendency.

While the general tendency is for decreasing concentrations with increasing depth, exceptions are noted as follows: boring RP-4, where volatile organic compounds, base/neutral compounds, acid extractable compounds, and total phenolics increase at the top of clay; boring RB-1, where copper, cadmium and arsenic increase at the top of clay; and RP-3, where zinc, cadmium and mercury increase at the top of clay. The sludge pit may be responsible for the exception at boring RB-1; no reasons for the exceptions at RP-3 and RP-4 were discerned.

4.3 GROUND WATER

4.3.1 Objectives and Methods

The objectives of this phase of the investigation were to:

- o characterize the aquifer(s) that underlie the site;
- o evaluate the direction(s) of ground water movement; and
- o evaluate the nature and extent of organic and inorganic chemical contaminants in the on-site ground water.

Four shallow piezometers, seven shallow monitoring wells and three till monitoring wells were initially installed to provide the necessary data for evaluation. Ten additional shallow piezometers were subsequently installed to provide a larger data base for evaluating shallow ground water flow.

Available information indicates that three aquifer systems are present in the site vicinity. In descending order, these are:

- o water table aquifer (shallow)
- o till aquifer (intermediate)
- o bedrock aquifer (deep)

The four piezometers were installed first, to obtain the general direction of ground water flow in the water table aquifer and to guide the placement of the shallow wells. To further assist in positioning the seven shallow wells, a terrain-conductivity survey was performed (Appendix C). Based on information collected from these two tasks, the seven shallow wells were located. In addition, three wells were installed in the till aquifer. These three wells were screened in the lower 15 feet of the aquifer.

Water samples were collected and analyzed from the seven shallow and three till wells to obtain information on the chemical quality of the ground water in these two aquifers.

Subsequent tasks were performed to further evaluate the water table aquifer. Historical aerial photographs (1932, 1940, 1951, 1953, 1962, 1972, 1978 and 1986), and information from the local sewer authority and the Meadowlands Sports Complex, were reviewed to identify pertinent subsurface features which may be influencing the aquifer. Furthermore, the ten additional piezometers were installed in the aquifer to assist in better characterizing the flow direction. The results of these tasks are discussed further in the following sections.

4.3.2 Water Table Aquifer

4.3.2.1 Hydrogeology

The water-bearing unit for the water table aquifer is the man-made fill and the underlying peat. The ground water table is very shallow, usually within 1 to 2 feet below ground surface and occurs under perched conditions on the underlying clay. Ground water elevations were measured and recorded at different times. Figures 25 and 26 are contour maps of the water table aquifer surface. As shown, lateral flow towards the center of the site as well as towards the perimeter of the site can be deduced.

To further evaluate these flow directions, ten additional piezometers were installed along the perimeter of the site. Additional ground water elevation measurements were then made, and compiled in the form of ground water elevation contour maps (Figures 27 to 32). Examination of these figures corroborates and further refines the results of the first two ground water monitoring events utilizing initial piezometer and monitoring well installation. It appears that lateral ground water flow in the water table aquifer is radially away from the

site, towards Peach Island Creek, Gotham Parkway, Paterson Plank Road and the adjoining property to the east. In addition, one set of water level measurements indicated a component of flow is towards the centerline of the site.

The lateral ground water flow patterns in the water table aquifer may be explained in the context of the site's subsurface conditions. The water table aquifer contains large quantities of man-made fill which is extremely variable in composition. As a result, the transmissivity (which is defined as the product of the saturated thickness times the permeability) can be expected to vary throughout the site. Slug test data from the on-site shallow wells indicate two orders-of-magnitude times variability in permeability values across the site within the fill materials (see detailed discussion below). Examination of historic aerial photographs indicates that different parts of the site were filled at different times. Information collected during piezometer, well and boring installation indicates that such diverse materials as shingles, construction debris and crushed stone were deposited at the site over the years. Random dumping, combined with variable compaction produced by the on-site daily activities, could have resulted in large variability in permeability. Furthermore, these materials may have been emplaced in the cells defined by the mosquito control trenches that were identified from historical aerial photographs. This could have led to the formation of more compacted and less porous areas in the centers of these cells. The position of these trenches (Figure 33) paralleled the southern and northern property lines, with one trench located near the northern property line, one near the center of the site and one near the southern property line. Mosquito control trenches were also present along the southern side of Paterson Plank Road. The backfilled trenches could have a tendency to define zones of high transmissivity, which, in turn, would influence the direction of ground water flow.

The exact dimensions of these trenches are not available, but through comparison with existing trenches, it can be inferred that the trenches were approximately 2 feet wide and extended 2 to 4 feet below the surface of the water. Over a period of time, these trenches were probably backfilled, most likely with miscellaneous fill material similar to that at the SCP site.

Given the probable types of backfill material (construction debris, miscellaneous soil, and rock), and the fact that backfill compaction control was likely absent, these trenches can be zones of permeability significantly higher than that of the surrounding soil.

In addition, sewer lines are located just outside the site property line along Paterson Plank Road and along Gotham Parkway. These sewer lines were installed in trenches excavated approximately to the top of the clay. The type of backfill material used is not known.

Furthermore, a system of gravity-fed subdrains, oriented perpendicular to Paterson Plank Road, is in operation at the property of the Meadowlands Sports Complex.

In urban areas, sewer and underground utility lines can also be a major factor in influencing ground water flow. Sewers often leak, typically at their joints, allowing ground water to enter the sewer system.

Though no conclusive information is available, it is possible that the individual and combined effect of these potential subsurface features and conditions on the water table aquifer could result in the ground water flow patterns observed. Additional work will be conducted to provide additional hydrogeologic data in the off-site areas. Once these data are obtained, ground water flow patterns will be reevaluated based on on-site and off-site data points. The enlarged data base will be used to evaluate previous interpretations and may result in their modification.

It must be noted that the above discussion relates solely to lateral ground water flow in the water table aquifer. A significant component of flow in this aquifer is downward into the underlying till aquifer (see discussion under "Till Aquifer Hydrogeology" in Section 4.3.3.1).

To evaluate tidal influence on the water table aquifer resulting from Peach Island Creek, continuous recording devices (Stevens Water Level Recorders) were installed on the well cluster MW-5. In addition, water level measurements at Peach Island Creek were made daily, during the period of well installation. A still-well was installed where Gotham Parkway crosses over Peach Island Creek, and the top of the PVC casing was surveyed to the same datum as the on-site wells. Hydrographs summarizing these measurements are presented in Appendix F. As shown, Peach Island Creek is subject to a tidal influence of an approximate amplitude of one foot. Additional measurements collected hourly over a 12-hour period (Appendix F) indicate that Peach Island Creek is subject to a simple 24 hour period tide. The wave-form of the tide seems to be asymmetric, indicating complex interactions between the incoming and the outflowing tides. This may influence sediment transport and flocculation patterns in Peach Island Creek.

A continuous recording device was installed in the shallow monitoring well MW-5S. Water levels were recorded for a period of eight weeks, although due to equipment malfunction, records are available for only six weeks. Copies of the individual records are included in Appendix F. Examination of these records indicates that water levels in MW-5S remain constant with time, resulting in a straight line hydrograph. This line is interrupted by occasional spikes, showing rapid increase in the level and then a smooth decline. These spikes coincide with precipitation events. Information on precipitation was obtained from NOAA records covering the same period. The NOAA records are included in Appendix F. The water table aquifer appears to respond very rapidly to precipitation events. This would be expected given that the

water table surface occurs approximately two feet below grade and the overlying surface material is very permeable (rubble and debris). Based on the straight-line form of the hydrograph, it appears that the tide experienced by the Peach Island Creek does not influence water levels in the water table aquifer. This may be due to a bank storage effect, the small water column of Peach Island Creek and the fact that the water table is significantly higher (approximately 5 feet) than the water surface of the creek.

Slug tests were performed on the shallow wells to evaluate the hydrologic parameters of the fill soils. The results were reduced using two different approaches (Cooper et al., and Bower and Rice). The results are summarized in Table 16. Permeability is in the 1×10^{-3} to 1×10^{-4} cm/sec range with the exception of MW-5S, which is in the 1×10^{-2} cm/sec range. However, MW-5S, was installed in a thick peat section. Transmissivity is in the 1×10^{-3} to 1×10^{-5} ft²/sec range. No clear trends were identified in any of these parameters. This is a result of the heterogeneity of the fill unit and the fact that slug tests results are representative of very small areas around the well. Slug test raw data and calculated results are included in Appendix D.

4.3.2.2 Water Quality - Water Table Aquifer

To date, two rounds of ground water samples have been collected (July 1987 and December, 1987) from seven shallow monitoring wells at the site. Ground water samples were analyzed for priority pollutants and some additional parameters. Analyses indicate the presence of a wide variety of contaminants including volatiles, acid extractables, base/neutrals, pesticides, PCBs, total cyanides, total phenolics, petroleum hydrocarbons and total and dissolved metals in the water table aquifer.

Complete analytical data summaries have been included in Appendix B. The occurrence, concentration, ranges, mean and standard

deviations of the chemicals detected in the water table aquifer are summarized in Tables 18 (July 1987) and 19 (December 1987). Figures 34 through 37 depict the spatial variation of ground water quality in the water table aquifer.

Volatile organic compounds (VOCs) were found at extremely high levels in the water table aquifer. The total VOC concentrations from the July 1987 sampling ranged from 2.7 mg/l at MW-6S to 2,564 mg/l (parts per million or ppm) at MW-7S. Comparable values from the December 1987 sampling were 3.2 mg/l at MW-6S to 1,501 mg/l at MW-7S. Well MW-3S had the next highest values from both sampling events: 1,491 mg/l in July 1987, and 1,426 mg/l in December 1987. No consistent temporal pattern is evident: some VOCs exhibited an increase in concentration over time, while others exhibited a decrease. The VOCs detected in MW-3S were chloroform, 1,2-dichloroethane, methylene chloride, toluene, 1,1,1-trichloroethane and trichloroethylene. These compounds, plus 1,1-dichloroethane, tetrachloroethylene, 1,2-trans-dichloroethylene and methyl ethyl ketone, were detected in MW-7S.

Acid extractable concentrations from the July 1987 sampling ranged from 0.045 mg/l at MW-6S to 18 mg/l at MW-7S, while the December 1987 sampling results ranged from 0.008 mg/l at MW-6S to 13.6 mg/l at MW-7S. The primary compound present was phenol. The temporal variations do not indicate any trends.

Base/neutral concentrations from the July 1987 sampling range from 0.024 mg/l at MW-2S to 68 mg/l at MW-3S. Comparable concentrations during the December 1987 sampling ranged from 0.018 mg/l at MW-6S to 67 mg/l at MW-3S. Only 1,2-dichlorobenzene and naphthalene were detected in more than two wells. The primary acid extractable compound detected in MW-3S was nitrobenzene (57.9 mg/l during both sampling events). Only one other well, MW-7S, contained nitrobenzene (29.4 mg/l and 24.9 mg/l for the two sampling events). Again, no consistent temporal trend is evident.

Pesticide compounds were present at low levels in wells MW-1S, MW-2S and MW-4S during both sampling events. Other than a value of 0.015 mg/l of endrin aldehyde in MW-4S during the July sampling event, all other concentrations were near or below 0.001 mg/l.

In the July 1987 sampling event, PCB quantified as Aroclor 1242 was detected in three wells: 0.116 mg/l in MW-3S, 0.0018 mg/l in MW-6S, and 0.233 mg/l in MW-7S. It was thought that the presence of small quantities of insoluble or suspended organics in the water samples may have biased the data because the solubility of PCBs in water is low (see Table 3). The presence of non-aqueous phase material in the sample would increase the measured concentrations. In order to evaluate the dissolved PCB concentration, a separation procedure was incorporated in the laboratory program during the December 1987 sampling event on split samples from the three wells. One sample from each well was analyzed as received, while the split sample was subject to the separation procedure prior to analysis. The separation procedure utilized separatory funnels and a high-speed centrifuge to remove, to the extent practical, non-aqueous phase material. The analysis of the December 1987 sampling did not detect PCBs in either the original or the split (subject to separation procedure) samples from both MW-6S and MW-7S. For well MW-3S, PCB quantified as Aroclor 1242 was detected at 17 mg/l in the original sample and 8.8 mg/l in the split sample. Thus, approximately half the PCB was dissolved in the sample, and the remainder was part of a non-aqueous phase. This dissolved fraction greatly exceeds the solubility of PCB in water, but the presence of VOCs in MW-3S could increase the solubility. It is not known why the concentration increased substantially from July to December.

Total cyanide concentrations for the July 1987 sampling event ranged from 0.03 mg/l at MW-4S to 3.64 mg/l at MW-7S. For the December 1987 sampling, the concentrations ranged from 0.027 mg/l at MW-6S to 4.52 mg/l at MW-7S.

Petroleum hydrocarbon concentrations ranged from less than 1 mg/l at MW-6S to 2270 mg/l at MW-3S for the July 1987 sampling, while those for the December 1987 sampling varied from concentrations of less than 1 mg/l at MW-6S to 45.4 mg/l at MW-7S.

Seven dissolved metals (arsenic, chromium, copper, mercury, nickel, silver and zinc) were detected in filtered samples during the July 1987 sampling episode, while six dissolved metals (arsenic, beryllium, chromium, copper, nickel and zinc) were detected in filtered samples during the December 1987 sampling. The maximum dissolved arsenic concentrations were 0.19 mg/l (MW-2S) in July and 1.6 mg/l (MW-1S) in December. The maximum dissolved beryllium concentration was 0.0013 mg/l (MW-1S) in December; none was detected in July. The maximum dissolved chromium concentrations were 0.32 mg/l in July and 0.42 mg/l in December, both in MW-7S, the only well in which it was detected. The maximum dissolved copper concentrations were 0.06 mg/l (MW-7S) in July and 0.05 mg/l (MW-3S) in December. The maximum dissolved mercury concentration was 0.00021 mg/l detected only in MW-7S and only in the July sampling. The maximum dissolved nickel concentrations were 0.15 mg/l in July and 0.08 mg/l in December, both in MW-1S. Dissolved silver was only detected once, in MW-2S during the July sampling, at 0.11 mg/l. The maximum concentrations of dissolved zinc were 0.69 mg/l in July and 0.14 mg/l in December, both in MW-3S.

Nine metals (arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel and zinc) were detected in unfiltered (total metal) samples in the water table aquifer during the July 1987 and December 1987 sampling episodes. The highest concentrations of total metals for the July 1987 sampling event are as follows:

- o 0.17 mg/l arsenic, MW-2S
- o 0.0011 mg/l beryllium, MW-5S
- o 0.005 mg/l cadmium, MW-2S

- o 0.33 mg/l chromium, MW-7S
- o 1.35 mg/l copper, MW-1S
- o 0.47 mg/l lead, MW-3S
- o 0.0044 mg/l mercury, MW-5S
- o 0.15 mg/l nickel, MW-1S
- o 2.08 mg/l zinc, MW-3S

The highest concentrations of total (unfiltered) metals for the December 1987 sampling event are as follows:

- o 3.1 mg/l arsenic, MW-4S
- o 0.0043 mg/l beryllium, MW-3S
- o 0.016 mg/l cadmium, MW-2S
- o 0.45 mg/l chromium, MW-7S
- o 1.58 mg/l copper, MW-1S
- o 1.5 mg/l lead, MW-3S
- o 0.0018 mg/l mercury, MW-3S
- o 0.18 mg/l nickel, MW-3S
- o 2.97 mg/l zinc, MW-3S

As the data indicate, no spatial or temporal trend is evident with respect to dissolved (filtered) and total (unfiltered) metals.

In addition to chemical analyses, field measurements of pH, temperature and conductivity were made. The results are summarized in Table 17. An attempt to normalize conductivity to 20°C proved futile because of the complexity of the chemical system involved.

The temperature of the water table aquifer is greatly influenced by the ambient air temperature, because of its proximity to ground surface. The pH of the ground water was higher at sampling points near Peach Island Creek and Paterson Plank Road and lower elsewhere. The conductivity of the ground water was measured to be highest at MW-7S and decreases rapidly away from it.

In conclusion, the analytical results from the water table aquifer correspond with the results of the subsurface soil investigation in the unsaturated and saturated fill. This indicates that the ground water has been contaminated by leaching of pollutants from the fill material. High concentrations of volatiles, acid extractables, base/neutrals, metals, total phenolics, total cyanides and total petroleum hydrocarbons exist in the water table aquifer. The highest concentrations were observed in monitoring wells MW-7S and MW-3S, while PCB quantified as Aroclor 1242 was detected in its dissolved state (December 1987 sampling) in MW-3S. The high values of specific conductivity detected across the site indicate the presence of high dissolved solid concentrations in the water table aquifer.

A water sample was collected from monitoring well MW-1S on August 26, 1988 for water quality analyses. The results are as follows:

- o Total dissolved solids - 4,000 mg/l
- o Chloride concentration - 1,450 mg/l
- o Sulfate concentration - 25 mg/l

4.3.3 Till Aquifer

4.3.3.1 Hydrogeology

The water bearing unit for this aquifer is the glacial till. Water level data show that this aquifer occurs under confined conditions.

During drilling, water was encountered in the till at a depth of approximately 50 feet below grade. Once the installations were completed and the wells were developed, water levels were recorded approximately 15 feet below grade, indicating a rise in the water level of approximately 35 feet. This indicates the existence of confined conditions. The upper confining unit is the clay and silt unit that overlies the till. The lower confining unit is the weathered bedrock surface. Based on the data

obtained during the site investigation, the clay and silt unit appears to be continuous across the site.

The piezometric surface (as interpreted from the three on-site till wells) indicates that ground water flow in the glacial till is toward the northwest, although minor directional variations are exhibited (Figures 39 through 45). The elevation of the piezometric surface is approximately 10 to 15 feet lower than the potentiometric surface of the water table aquifer, indicating a downward hydraulic gradient between the two aquifers. The head differential between the water table aquifer and the till aquifer is a measure of the potential for downward flow between the two aquifers. Chemical data collected (discussed below in Section 4.3.3.2) along with the water level measurements confirm that downward flow from the water table aquifer to the till aquifer has occurred.

The permeability of the till aquifer is inferred to be low. During till well development, the three wells were pumped dry or nearly dry at a pumping rate of 1.5 to 2.0 gpm. However, this is only indicative of overall conditions at these three wells, and no numerical estimates of permeability can be made. Future plans are to quantify permeability.

A continuous recording device (Stevens Water Level Recorder) was installed on the till monitoring well MW-5D. Water levels were monitored for a period of eight weeks, although due to equipment malfunction, records are available for only six weeks. Appendix F contains copies of the hydrographs. A seven-day period fluctuation and a 12-hour fluctuation were recorded. It appears that the high water levels were always recorded on Mondays, while the lowest levels were always recorded on Fridays. This observation indicates that the water levels may be recording the influence of a nearby well(s) operating Monday through Friday and idling on weekends. The 12-hour fluctuation is tidal in origin, has an amplitude of approximately 0.1 feet and a symmetric waveform.

Since there are no similar records for the other two till wells, it is not possible to predict whether all the wells behave in the same fashion or not. It is expected that changes in the water elevation will produce changes in the direction of ground-water flow. The magnitude of these changes will depend upon the response of the different sections of the aquifer. Examination of the piezometric surface contour maps for the till aquifer indicate that flow directions and gradients tend to be fairly constant with time. To date, no extraordinary events (such as flow reversals) have been recorded.

4.3.3.2 Water Quality - Till Aquifer

Ground water samples were collected on two separate occasions (July, 1987 and December, 1987) from the three till wells.

The analytical results from the two sampling episodes are presented in Appendix B, while Tables 21 and 22, and Figures 47 through 50, illustrate the analytical results from the till aquifer during the two sampling episodes. The ground water samples contained a number of organic and inorganic chemical substances.

The VOCs detected at the highest concentrations in the July 1987 sampling event include chloroform (28.6 mg/l), 1,2-dichloroethane (9.23 mg/l) and trichloroethylene (6.26 mg/l), all at well MW-2D. Except for these VOCs at MW-2D and for 4.52 mg/l of trichloroethylene at MW-5D, all other individual VOCs detected in the three wells were less than 1.0 mg/l in concentration. In the December 1987 sampling event, MW-2D again had the highest concentrations of VOCs: chloroform (8.38 mg/l), 1,2-dichloroethane (11.2 mg/l), trichloroethylene (34.5 mg/l), and tetrachloroethylene (10.6 mg/l), which showed a marked increase from the July 1987 concentration (0.0177 mg/l) at the same well. In addition, other VOCs were detected during the December sampling. Except for 1,1-dichloroethane, toluene and vinyl chloride, the VOC concentrations increased in MW-2D between the two sampling events. Concentrations decreased at MW-7D, and no trend was evident at MW-5D.

Lower levels of other organic compounds were detected in the till aquifer during either one or both sampling events. These include phenol, 1,2-dichlorobenzene, nitrobenzene, petroleum hydrocarbons, and one PCB Aroclor (1232). The concentrations are listed on Tables 21 and 22. All of the organics detected in the till aquifer samples were also found in the soils and water table aquifer at the site.

The detection of PCB quantified as Aroclor 1232 at 0.0018 mg/l in MW-5D during the December 1987 sampling is considered anomalous because this Aroclor was not detected in any other sample from the soil, water table aquifer, surface water or sediment. Furthermore, PCB quantified as this Aroclor was detected in an Ebasco field blank split sample at a concentration of 0.003 mg/l (see Appendix B).

Dissolved zinc (filtered sample), total copper and total zinc (unfiltered samples) were detected in both sampling events. The total zinc concentration in MW-2D in the July 1987 sampling event was 0.045 mg/l; no dissolved zinc was detected. The same pattern holds for the December 1987 event, where only total zinc was detected in MW-2D at a concentration of 0.036 mg/l. Total copper at MW-2D decreased from 0.019 mg/l in July to non-detected in December. In well MW-5D, no metals were detected in July, while total zinc (0.022 mg/l) and dissolved zinc (0.021 mg/l) were detected in December. In well MW-7D, both total and dissolved zinc were detected in both sampling events: 0.039 mg/l and 0.030 mg/l, respectively, in July; 0.057 mg/l and 0.020 mg/l, respectively, in December. An unusual trend is evident in these MW-7D data: the dissolved concentration decreased while the total concentration increased. It is difficult to draw conclusions based on two sampling events and the low concentrations detected.

The variations in clay thickness beneath the overburden fill material from a 9-foot thick silty clay at MW-2D, to a thicker stratum of 10 feet at MW-5D, to finally the thickest stratum of 28 feet present at MW-7D, appeared to have influenced the transport of organic and inorganic

chemicals from the overburden fill downward. There is a clear attenuation of volatiles in RMW-7D. However, there is no such attenuation observed in RMW-5D or in RMW-2D (Figure 24). As discussed in Section 4.2.3, volatile organics were detected in the clay at levels higher than any other organic compounds, which, when detected, were at low concentrations. The relatively thinner and siltier clay present at MW-2D may be the reason that the highest concentrations of VOCs in the till aquifer were detected in MW-2D.

The volatile organics detected at MW-2D and MW-5D do not have the chemical profile of the ground water found in MW-2S and MW-5S, but have a similar profile to the clay samples taken from their respective borings. In boring RMW-2D clay samples, the four VOCs detected were chloroform, 1,2-dichloroethane, methylene chloride, trichloroethylene. These same four compounds had the highest concentrations in the July 1987 water sample from MW-2D. Trichloroethylene had the maximum concentration in the MW-2D December 1987 water sample. Most of the VOCs detected in the MW-5D water samples were also detected in the clay samples in boring RMW-5D. In the case of MW-7D, the VOC profile of the ground water in the till zone is quite similar to that of the ground water at MW-7S and the VOCs in the clay samples from boring RMW-7D. The six VOCs detected in the July 1987 MW-7D water sample comprised the majority of the VOCs detected in the July 1987 MW-7S water sample. Similarly, the three VOCs detected in the December 1987 MW-7D water sample comprised the majority of the December 1987 MW-7S water sample. In boring RMW-7D clay samples, the most prevalent VOCs were methylene chloride, tetrachloroethylene, toluene and trichloroethylene. Chloroform and 1,1,1-trichloroethane were also detected. These compounds were detected in MW-7D water samples during either one or both sampling events.

Temperature, pH and conductivity were measured in the field. An attempt to normalize conductivity to 20°C did not produce meaningful results because of the complex chemical systems involved. The results of the field measurements are listed in Table 20.

Conductivity stayed relatively constant over time, except for samples collected from MW-5D, where an order of magnitude change was observed. Temperature increased from north to south in the summer, and from south to north in the winter. The pH, in both instances, was highest at MW-2D and decreased towards the west.

A water sample was collected from monitoring well MW-7D on August 26, 1988 for water quality analyses. This well was selected because it is an on-site upgradient well in the till aquifer, and had the least concentrations of volatile organics of the three till wells. The results are as follows:

- o Total dissolved solids - 610 mg/l
- o Chloride concentration - 43.3 mg/l
- o Sulfate concentration - 350 mg/l

In conclusion, the water in the till aquifer contains primarily volatile organic compounds. The chemicals detected in the till aquifer are also found at higher concentrations in the water table aquifer and fill material, indicating that these contaminants have migrated through the clay layer from the overlying fill and water table aquifer. The highest concentrations of VOCs were detected at MW-2D and MW-5D; this is probably due to the thinner and siltier clay layers present in these areas.

5.0 SURFACE WATER INVESTIGATION

5.1 SURFACE WATER

5.1.1 Objectives and Methods

The objective of this phase of the investigation was to evaluate contamination of the surface water in the vicinity of the site. The

measurement of surface water flow rates and the evaluation of possible tidal effects on the flow rates were not planned nor performed as part of the Remedial Investigation, and therefore, is not discussed in this report.

Four stations along Peach Island Creek were selected for sampling:

- o Station 1: The confluence of Peach Island Creek and Berry's Creek (approximately one-half mile downstream from the site).
- o Station 2: 100 ft. downstream from the site.
- o Station 3: Adjacent to the center line of the site.
- o Station 4: 100 ft. upstream from the site.

Figure 51 identifies the four stations.

5.1.2 Surface Water Quality

Surface water samples were collected during low tide from the four stream stations described in Section 5.1.1. Sampling occurred during July 1987 (immediately after a precipitation event) and December 1987 (representing low stream flow conditions). Figures 52 through 55 illustrate the spatial variation of surface water quality in the vicinity of the SCP site. Tables 23 and 24 describe the occurrence, concentration ranges, mean and standard deviation of volatile organics, total cyanides, total phenolics, total petroleum hydrocarbons and the metals detected in the surface water samples for the above-mentioned sampling periods. Table 25 lists the concentrations of each compound found, by station. Data summary sheets for the two sampling events are included in Appendix B.

As shown on Table 25, VOCs were the most prevalent organic chemicals detected in Peach Island Creek. In the July 1987 sampling event, 5 VOCs were detected above the method detection limit (MDL):

chloroform, with a maximum concentration of 1.84 ug/l adjacent to the site at station SW-3; 1,2-dichloroethane, with a maximum concentration of 5.27 ug/l downstream of the site at SW-2; methylene chloride, with a maximum concentration of 17.0 ug/l downstream of the site at SW-1; 1,2-trans-dichloroethylene, with a maximum concentration of 9.56 ug/l adjacent to the site at SW-3; and 1,1,1-trichloroethane, with a maximum concentration of 12.9 ug/l adjacent to the site at SW-3. The highest concentration of each of these five VOCs was either immediately adjacent to the site (SW-3) or downstream of the site at SW-2.

In the December 1987 sampling event, 11 VOCs were detected above their MDLs. Almost all of these VOCs were detected at the highest concentrations immediately adjacent to the site (SW-3) or just downstream of the site at SW-2. One VOC had its maximum concentration upstream of the site, at SW-4: methyl ethyl ketone (MEK) at 75 ug/l. This value decreased downstream, and MEK was not detected at the confluence of Peach Island Creek and Berry's Creek (SW-1). Four VOCs had maximum concentrations adjacent to the site, at SW-3: chloroform at 3.58 ug/l; 1,2-trans-dichloroethylene at 35.2 ug/l; 1,1,1-trichloroethane at 6.32 ug/l; and trichloroethylene at 3.83 ug/l. None of these compounds was detected upstream of the site, and all had decreasing or non-detected concentrations downstream of the site. Six VOCs had maximum concentrations downstream of the site, including these five at SW-2: chlorobenzene at 12.2 ug/l; 1,2-dichloroethane at 15.3 ug/l; toluene at 48.1 ug/l; m-xylene at 10.7 ug/l; and o+p-xylenes at 10.0 ug/l. At the confluence of the two creeks (SW-1), methylene chloride had a maximum concentration of 14.9 ug/l, and successively decreased in concentration at each upstream station.

No consistent temporal pattern regarding VOCs was observed when comparing the two samples from each station. Some concentrations decreased, while others increased. The increases tended to be more prevalent, and more substantial in terms of absolute numbers. This is illustrated by the chlorobenzene, methylene chloride, methyl ethyl ketone

and xylenes at SW-2; the chlorobenzene, 1,2-dichloroethane, toluene, and methyl ethyl ketone at SW-3; and the methyl ethyl ketone at SW-4. In these cases, the concentrations increased from non-detected in July 1987 to the low-to-mid-ug/l range in December 1987. The general trend is for increasing concentrations from the July sampling to the December sampling. This may be due to the hydrologic conditions which varied by sampling rounds. The July 1987 sampling event was planned to coincide with a recent rainfall event, while the December 1987 sampling event was planned to coincide with a relatively dry period. Both sampling events occurred at low tide.

Total phenolics were detected downstream of the site: 133 ug/l at SW-2 in December 1987, and 61 ug/l at SW-1 in July 1987. No patterns or trends can be observed from only these two pieces of data.

As shown on Table 25, four dissolved metals were detected in Peach Island Creek. In the July 1987 sampling event, nickel and zinc were detected: nickel at all four stations at 10 ug/l to 11 ug/l, and zinc with a maximum concentration of 150 ug/l at SW-3, a lower concentration upstream (94 ug/l), and decreasing concentrations downstream. In the December 1987 sampling event, the nickel concentrations increased, except at SW-4, to a maximum concentration of 49 ug/l upstream of the site at SW-4. Zinc decreased at two stations (SW-2 and SW-3) and increased at two stations (SW-1 and SW-4), with a maximum concentration of 130 ug/l at SW-4. Copper was detected at the three upstream stations at concentrations ranging from 13 ug/l to 16 ug/l. Mercury was detected above the MDL only at SW-1, at a concentration of 0.63 ug/l. No patterns or trends are evident for the dissolved metals when comparing the two rounds of sampling data at each station.

An examination of the total metals data on Table 25 indicates that the maximum concentrations of the four metals detected in the July 1987 sampling event occurred at two stations: copper (40 ug/l) and zinc

(160 ug/l) at SW-4 upstream of the site, and mercury (0.23 ug/l) and nickel (31 ug/l) at SW-1 downstream of the site at the confluence of the two creeks. In the December 1987 sampling event, the maximum concentrations of the five metals detected (including chromium, which was not detected as a dissolved metal) occurred upstream of the site at SW-4: chromium (50 ug/l), copper (100 ug/l), mercury (4.8 ug/l), nickel (57 ug/l) and zinc (370 ug/l).

The surface water quality was compared with the ground water quality in wells MW-5S, MW-6S, and MW-7S, which are the shallow wells nearest the creek. The substances found in the surface water are present in the water table aquifer adjacent to the creek, except for chloroform, which is present elsewhere on-site. The VOCs in the surface water are also similar to those found in the till aquifer. Thus, it appears that some of the more mobile compounds in the water table aquifer are entering the creek as well as the till aquifer.

In summary, volatile organic compounds, total phenolics and five metals were detected within the surface water of Peach Island Creek. The concentrations associated with the compounds detected are lower than the concentrations of the same compounds detected in the water table aquifer.

A water sample was collected from Peach Island Creek on August 26, 1988 for water quality analyses. The sample was collected at mean high tide from the Gotham Parkway Bridge. The results are as follows:

- o Salinity - 4.2 g/kg
- o Hardness - 1,520 mg/l

The salinity analysis shows that the stream is saline adjacent to the site.

5.2 SEDIMENTS

5.2.1 Objective and Methods

The objective of this phase of the investigation was to evaluate the chemical quality of sediment in Peach Island Creek.

Four locations along Peach Island Creek were selected for sampling, corresponding to the locations of surface water sampling (Figure 51). Two sediment samples were collected at each location, from 0 to 6 inches and from 12 to 18 inches below the surface of the stream bed.

The stream-bottom sediments are waterlogged organic silt.

5.2.2 Sediment Quality

Numerous organic and inorganic chemical contaminants were detected in the sediment samples collected from the four stream stations. Table 26 illustrates the occurrence of compounds detected in the sediment. Figures 56 through 59 provide schematic representations of the analytical results at the four sampling stations from the December 1987 sampling episode, while the analytical data summary sheets have been included in Appendix B.

The highest levels of VOCs were found adjacent to the site at station 3, in both the 0 to 6-inch sample (16,241 mg/kg) and the 12- to 18-inch sample (6,348 mg/kg). The VOCs in the upper sample included: ethylbenzene (439 mg/kg), tetrachloroethylene (953 mg/kg), toluene (2,970 mg/kg), trichloroethylene (9,950 mg/kg), m-xylene (1,060 mg/kg), and o+p-xylenes (647 mg/kg). These individual concentrations were the maximum for those compounds at that sampling interval. In addition, chlorobenzene at 17.1 mg/kg, chloroform at 3.69 mg/kg and methyl ethyl ketone at 18.3 mg/kg (all at station 2) had maximum values at that

sampling interval. The VOCs in the deeper sample at station 3 included: ethylbenzene (174 mg/kg), tetrachloroethylene (304 mg/kg), toluene (1,700 mg/kg), 1,1,1-trichloroethane (75.5 mg/kg), trichloroethylene (3,260 mg/kg), m-xylene (486 mg/kg), and o+p-xylenes (348 mg/kg). Again, these were all maximum concentrations at that depth. Other maximum concentrations in the 12- to 18-inch depth included:

- o 1.99 mg/kg benzene, station 4 (upstream)
- o 9.59 mg/kg chlorobenzene, station 2 (downstream)
- o 3.79 mg/kg chloroform, station 4 (upstream)
- o 1.96 mg/kg 1,2-dichloroethane, station 4 (upstream)
- o 3.69 mg/kg methylene chloride, station 4 (upstream)
- o 1.61 mg/kg 1,2-trans-dichloroethylene, station 4 (upstream)
- o 31.9 mg/kg methyl ethyl ketone, station 4 (upstream)

At stations 1, 2, and 3, the trend is decreasing VOC concentrations with increasing depth. Spatially, the VOC concentrations are highest at station 3 and substantially lower both upstream and downstream, to concentrations of 1 mg/kg or less at the confluence of Peach Island Creek and Berry's Creek (station 1). This pattern holds for both sampling intervals.

Acid extractable compounds consist of 2,4-dichlorophenol (1.36 mg/kg, 0-6-inch sample, station 4) and phenol:

- o 10.2 mg/kg phenol, 0-6-inch sample, station 3 (site)
- o 44.7 mg/kg phenol, 12-18-inch sample, station 3 (site)
- o 24.9 mg/kg phenol, 0-6-inch sample, station 4 (upstream)
- o 6.56 mg/kg phenol, 12-18-inch sample, station 4 (upstream)

Phenol was not detected at either of the downstream stations. No vertical or spatial trend is evident from the data.

Numerous base/neutral compounds were detected. Maximum values in the 0-6-inch samples included:

- o 10.8 mg/kg bis (2-ethylhexyl) phthalate, station 4 (upstream)
- o 3.67 mg/kg 1,2-dichlorobenzene, station 3 (site)
- o 2.35 mg/kg di-n-butyl phthalate, station 4 (upstream)
- o 1.33 mg/kg naphthalene, station 4 (upstream)
- o 1.82 mg/kg phenanthrene, station 4 (upstream)

These maximum values consistently decrease downstream.

The maximum values in the 12-18-inch sample included:

- o 1.53 mg/kg benzo (b) fluoranthene, station 2 (downstream)
- o 356 mg/kg bis (2-ethylhexyl) phthalate, station 2 (downstream)
- o 9.7 mg/kg butyl benzyl phthalate, station 3 (site)
- o 1.1 mg/kg chrysene, station 2 (downstream)
- o 261 mg/kg 1,2-dichlorobenzene, station 3 (site)
- o 7.84 mg/kg 1,4-dichlorobenzene, station 3 (site)
- o 24.8 mg/kg di-n-butyl phthalate, station 3 (site)
- o 12.2 mg/kg di-n-octyl phthalate, station 3 (site)
- o 2.26 mg/kg fluoranthene, station 2 (downstream)
- o 20.3 mg/kg naphthalene, station 3 (site)
- o 2.75 mg/kg phenanthrene, station 2 (downstream)
- o 1.85 mg/kg pyrene, station 2 (downstream)
- o 2.33 mg/kg 1,2,4-trichlorobenzene, station 3 (site)

As with the upper sample, these maximum values all consistently decrease downstream. There was no consistent trend with respect to the vertical distribution at each station. The highest concentrations of base/neutral compounds in this interval are either adjacent to the site or immediately downstream. The total B/NC concentrations were highest upstream of the site (station 4) in the 0-6-inch sample, with generally

decreasing concentrations downstream (note that stations 2 and 3 had approximately the same concentrations). Station 1 consistently had the lowest B/NC concentrations by parameter and in total.

PCBs detected in the sediment were quantified as the following four Aroclors: 1242, 1248, 1254 and 1260. In the 0-6-inch samples, PCB quantified as Aroclor 1242 had a maximum concentration of 55 mg/kg adjacent to the site at station 3; the upstream concentration was 21 mg/kg, while the downstream concentrations were 35 mg/kg (station 2) and non-detected (station 1). PCB quantified as Aroclor 1260 was detected at 10 mg/kg upstream of the site at station 4, and at 6 mg/kg immediately downstream of the site at station 2; it was not detected at stations 1 and 3. However, PCB quantified as Aroclor 1254 at 5.2 mg/kg and PCB quantified as Aroclor 1248 at 19 mg/kg were detected only at station 1. Based on individual Aroclors, the only spatial trend at this depth occurs for PCB quantified as Aroclor 1242, where concentrations are highest adjacent to the site and decrease with distance up or downstream. Total PCB concentrations follow the same trend.

In the 12-18-inch interval, a similar pattern is observed. PCB quantified as Aroclor 1242 had a maximum concentration of 770 mg/kg at station 3, with concentrations decreasing upstream (8.8 mg/kg) and downstream (87 mg/kg at station 2, non-detected at station 1). PCB quantified as Aroclor 1260 was detected at 2.8 mg/kg upstream of the site at station 4, and at 22 mg/kg immediately downstream of the site at station 2; it was not detected at stations 1 and 3. However, PCB quantified as Aroclor 1248 was detected only at station at 1, at 42 mg/kg. The spatial trend at this depth follows that for the upper samples, both for PCB quantified as Aroclor 1242 and total PCBs: highest concentrations at the site at station 3, and consistently decreasing downstream.

The vertical distribution of PCBs shows consistently increasing concentrations with increasing depth.

Only one pesticide compound was detected in any sample from either depth: 11 mg/kg of dieldrin in the 0-6-inch sample from station 3.

The highest concentration of total cyanide in the 0-6-inch samples is 205 mg/kg, adjacent to the site at station 3. In the 12-18-inch sample, the highest concentration is 36 mg/kg at station 2. The only spatial trend observed at either depth is that the higher concentrations occur at stations 3 and 4, with substantially lower concentrations at stations 1 and 2. The vertical distribution is generally decreasing concentrations with increasing depth. However, station 2 is an exception, exhibiting an opposite trend.

Petroleum hydrocarbon concentrations in the 0-6-inch sample vary as follows:

- o 25,900 mg/kg at station 4 (upstream)
- o 20,200 mg/kg at station 3 (site)
- o 8,560 mg/kg at station 1 (Berry's Creek)
- o 4,400 mg/kg at station 2 (downstream)

In the 12-18 inch samples, the concentrations are as follows:

- o 10,900 mg/kg at station 3 (site)
- o 9,450 mg/kg at station 4 (upstream)
- o 8,980 mg/kg at station 1 (Berry's Creek)
- o 5,960 mg/kg at station 2 (downstream)

While the concentrations at stations 3 and 4 decrease substantially with depth, the concentrations at stations 1 and 2 increase slightly. Thus, no vertical distribution trend is observed. Spatially, the 0-6 inch samples exhibit significantly higher concentrations in the upstream samples, while smaller differences are observed in the 12-18 inch samples.

The total phenolic concentration in the 0-6 inch samples was highest at station 3 (315 mg/kg), and decreased both upstream (94 mg/kg) and downstream (15 mg/kg and 23 mg/kg at stations 2 and 1, respectively). At the 12-18 inch depth, a similar pattern was observed: a maximum concentration of 126 mg/kg at station 3, decreasing both upstream (12 mg/kg) and downstream (16 mg/kg and 36 mg/kg at stations 2 and 1, respectively). Vertically, there is a substantial decrease in concentrations with depth at stations 3 and 4, while slight increases with depth were observed at stations 1 and 2.

Twelve metals were detected in the sediment samples. The maximum concentrations of each are listed below for the 0-6 inch samples:

- o 37 mg/kg arsenic, station 4 (upstream)
- o 2.4 mg/kg beryllium, station 4 (upstream)
- o 83.7 mg/kg cadmium, station 4 (upstream)
- o 1,060 mg/kg chromium, station 1 (Berry's Creek)
- o 9,510 mg/kg copper, station 4 (upstream)
- o 520 mg/kg lead, station 3 (site)
- o 139 mg/kg mercury, station 1 (Berry's Creek)
- o 467 mg/kg nickel, station 4 (upstream)
- o 0.890 mg/kg selenium, station 1 (Berry's Creek)
- o 8.6 mg/kg silver, station 1 (Berry's Creek)
- o 1.1 mg/kg thallium, station 1 (Berry's Creek)
- o 3,110 mg/kg zinc, station 4 (upstream)

Station 4 has the highest overall metal content. No other spatial trends are evident.

The maximum concentrations in the 12-18 inch samples are listed below:

- o 31 mg/kg arsenic, station 1 (Berry's Creek)
- o 2 mg/kg beryllium, station 3 (site)
- o 739 mg/kg cadmium, station 3 (site)

- o 1,170 mg/kg chromium, station 1 (Berry's Creek)
- o 2,590 mg/kg copper, station 3 (site)
- o 450 mg/kg lead, station 2 (downstream)
- o 139 mg/kg mercury, station 1 (Berry's Creek)
- o 436 mg/kg nickel, station 2 (downstream)
- o 7.6 mg/kg silver, station 1 (Berry's Creek)
- o 1.2 mg/kg thallium, station 1 (Berry's Creek)
- o 3,680 mg/kg zinc, station 1 (Berry's Creek)

As the above table indicates, station 4 (by its absence) has the lowest overall metal content at this depth. No other spatial trends are evident. Similarly, no trends are evident with respect to the vertical distribution of metals at each station.

The organic and inorganic chemical compounds present in the sediment at all four stations are similar in type to the compounds found in the soils from the 0 to 2-foot and 5 to 6-foot sampling intervals of the borings nearest the Creek (RMW-5S, RMW-6S, RMW-7S and RB-1), indicating that contaminants have migrated from the site into the Creek.

The following discussion summarizes the spatial distribution of all chemicals in the 0 to 6-inch interval. Volatile concentrations are generally highest (relative to other sediment samples) adjacent to the site (station 3) and decrease upstream and downstream of the site. The two acid compounds identified (2,4-dimethylphenol and phenol) are highest upstream of the site (station 4), and only phenol was identified at any other station (station 3). The significant concentrations of base/neutral compounds were also generally highest upstream (station 4), with decreased concentrations downstream. PCB distribution varies by Aroclor: PCB quantified as Aroclor 1242 is highest adjacent to the site (at station 3), and decreases upstream and downstream; PCB quantified as Aroclors 1248 and 1254 are present at station 1 but undetected upstream; and PCB quantified as Aroclor 1260 is highest upstream at station 4 and decreases downstream. The one pesticide identified, dieldrin, was

present only adjacent to the site (at station 3). The highest concentration of total cyanide is at station 3, with decreasing concentrations both upstream and downstream. Total phenolic concentration is highest at station 3, with decreasing concentrations both upstream and downstream. The highest concentrations of metals are generally found at stations 1 and 4 (lead is the exception, at station 3).

The following discussion summarizes the spatial distribution of chemicals in the 12 to 18-inch interval. The volatile concentrations are highest adjacent to the site (at station 3). The one acid compound identified, phenol, is at its highest concentration adjacent to the site (at station 3), decreasing in concentration upstream and absent downstream. The concentrations of base/neutral compounds are highest at stations 2 and 3, and decrease in concentration upstream and downstream. PCB distribution varies by Aroclor: PCB quantified as Aroclor 1242 is highest adjacent to the site (at station 3), and decreased upstream and downstream; PCB quantified as Aroclor 1248 was detected only at station 1; and PCB quantified as Aroclor 1260 is highest at station 2, and present again only at station 4 upstream. No pesticides were identified at any station in this sampling interval. The highest concentration of total cyanide is at station 2, with decreasing concentrations both upstream and downstream. Petroleum hydrocarbon concentration is highest adjacent to the site (at station 3), although the concentrations at stations 1 and 4 are not significantly lower. Total phenolic concentration is highest at station 3, and generally decreases in concentration both upstream and downstream. The highest concentrations of metals are found at stations 1, 2 and 3.

From the above discussions, it is apparent that there is a general trend of decreasing concentrations of organic and inorganic chemicals in the sediment with distance from the site. It is not known if tidal action influences the distribution of the chemicals. The data suggest, however, that the results at station 1 may be influenced more by the deposition of sediments from Berry's Creek than from Peach Island

Creek, particularly with respect to the metals and PCB quantified as Aroclors 1248 and 1254. Aerial photographs indicate a sediment plane extending from the confluence of the two creeks upstream past Station 1. The embankment across Peach Island Creek downstream of station 2 may serve to impede sediment transport downstream. Although four small-diameter culverts pass beneath the embankment to allow stream flow, there is a substantial build-up of sediments immediately upstream of the embankment. Five to seven feet of soft, slurry-like sediments were encountered at mid-channel during sediment sampling at station 2, but not at the other three stations.

Certain anomalies in the upstream sediment data were observed. The highest concentrations of numerous compounds are found in the 0-6 inch sample from station 4, which is upstream from the site. With respect to sediment, three compounds are found exclusively in the sediment at station 4: 2,4-dimethylphenol (0 to 6-inch sample), 1,2-dichloroethane (12 to 18-inch sample), and 1,2-trans-dichloroethylene (12 to 18-inch sample). These compounds are, however, found in the soil at the SCP site. Additionally, four compounds were found in the sediment at station 4, but not at station 3, immediately downstream and adjacent to the site: chloroform (12 to 18-inch sample), methylene chloride (12 to 18-inch sample) methyl ethyl ketone (12 to 18-inch sample) and PCB quantified as Aroclor 1260 (0 to 6-inch and 12 to 18-inch samples). The cause(s) of these anomalies is not known, but may include tidal influences redistributing sediments. The scope of work upon which this RI was based was not designed to permit a determination of the cause(s) of these anomalies, but further study may be conducted in the future.

5.3 FLOOD POTENTIAL

The site is located on the flood plain of Peach Island Creek. Most of the site (approximately 80 percent) is within the 100-year flood plain (Zone A4), with a base flood elevation of 6 feet. The entire site is within the 500-year flood boundary. The base flood elevation line for the 500-year flood at the site is 6.3 feet (Reference 19).

5.4 DRAINAGE

5.4.1 Setting

The SCP site is located within the Hackensack Meadowlands. This is an extensive area of salt water marshes that are drained by the Hackensack River and its tributaries. Of those tributaries, Berry's Creek drains approximately 800 acres of marshland. Berry's Creek receives the waters of a number of drainage ditches and natural tributaries. One of the tributaries of Berry's Creek is Peach Island Creek, which flows adjacent to the site.

5.4.2 Peach Island Creek

Peach Island Creek flows along the northeastern side of the SCP site in a general north-northwesterly direction for a total distance of approximately one mile. Peach Island Creek is classified on the National Wetlands Inventory map (Reference 6A) as E1OW (estuarine, subtidal, open water). Peach Island Creek is part of the Walden Swamp drainage system and feeds into Berry's Creek. Examination of historic information (mosquito control trench map, Figure 33) and aerial photographs (1932, 1940, 1951, 1953, 1962, 1972, 1978 and 1986) indicate that over the years Peach Island Creek has been modified by human activity (mostly disposal of debris, and dredging). The depth of the Creek adjacent to the site is 2 to 3 feet at the deepest point and as little as 0.2 feet at the shallowest point.

Peach Island Creek receives the waters of small tributaries and drainage ditches. It also receives run-off from paved properties that are along the banks of the Creek.

Information collected from the tidal staff installed on the Gotham Parkway/Peach Island Creek Bridge indicate that the Creek is tidal. Daily water level fluctuations of a few tenths of a foot were

recorded, suggesting that a low amplitude tide is experienced by Peach Island Creek in the vicinity of the site. However, information collected at the same location indicates that the water level of the Creek is very sensitive to even small amounts of precipitation, responding rapidly to rainfall events.

The stream-bottom sediments are mostly waterlogged organic silt.

5.4.3 Site Drainage

The SCP site exhibits very little relief and, except for small areas occupied by building floor-slabs, is unpaved. There are no drainage ditches or erosion gullies leaving the site. It is, therefore, reasonable to assume that most of the precipitation that the site receives infiltrates into the ground and only small quantities run off into the adjacent streams and roadways.

6.0 AIR MONITORING

An air quality investigation was not performed as part of this study. The approved Work Plan which governed the RI did not include an air investigation. Air quality monitoring was performed during the Remedial Investigation for worker health and safety. Level D personnel protection (no respirators) was indicated for activities that were not ground-intrusive; Level C personnel protection (respirator use) was frequently required for ground-intrusive activities such as drilling. The monitoring results are included and discussed in Appendix G.

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TABLE 1

WELL DATA — VICINITY OF SCP SITE⁽¹⁾
CARLSTADT, NEW JERSEY

(See Figure 5 for Well Locations)

Owner and Address	Index ⁽²⁾ No.	Date Drilled	Surface Elevation (ft)(MSL)	Well Depth (ft)	Static Water Level (ft)	Depth to Bedrock (ft)	Well Use
Berger Iron & Eng. Co. Rt. 17, Carlstadt	1	10/15/64	N/A	205	68	45	Industrial
Benedict Packing Corp. 590 Commercial Ave.	2	11/6/64	20	153	34	27	Cooling
Manhattan Products Co. Grand & Starly Ave.	3	10/20/85	15	300	26	80	Industrial
Carter Manufacturing Co. 55 Anderson Ave.	4	3/1/81	18	202	12	142	Cooling
World Plastic Extruders, Inc. 150 W. Commercial Ave.	5	9/12/68	N/A	200	40	53	Cooling
Verflex Co., Inc. 115 Monachie Ave.	6	N/A	N/A	N/A	N/A	N/A	Cooling ⁽⁴⁾
Caughey's 64 Hoboken Rd.	8	8/14/51	10	276	25	201	Cooling
Trubreck Laboratories Rt. 17, E. Rutherford	9	3/10/58	N/A	205	20	N/A	Industrial
Trubreck Laboratories Rt. 17, E. Rutherford	10	10/10/56	10	201	20	100	Industrial
Trubreck Laboratories Rt. 17, E. Rutherford	11	6/49	10	140	6	N/A	Industrial
Becton Dickinson & Co. Rt. 17, E. Rutherford	12	8/1/66	15	363	50	N/A	Lavatory
Marijon Piece Dye Co. Manor Rd.	14	7/1/65	5	285	50	N/A	Cooling
Marijon Dye & Finishing Co. 219 Murry Parkway	15	4/18/81	N/A	410	16	115	Industrial
Mr. Arthur DeBernado 125 Clinton Pl.	16	1963	N/A	175	N/A	N/A	Domestic ⁽⁷⁾
Top Notch Metal Co. Paterson Plank Rd.	17	7/3/73	30	400	30	78	Cooling
Spear Packing Co. 95 Broadway	18	10/28/79	16	330	18	162	Non-contact Cooling
Spear Packing Co. 95 Broadway	19	1/25/81	28	300	17	130	Non-contact Cooling
Marathon Enterprises E. Union Ave.	20	2/10/80	18	242	14	N/A	Unknown ^{(4),(5)}
Vikeship Co. Murray Hill Parkway	21	5/19/66	N/A	223	42	41	Washing Dumpsters
Carmet Mfg. Co. 120 E. Union Ave.	22	1/20/65	10	200	40	41	Cooling
U.S. Printing Ink Co. Union St.	23	1/23/65	15	220	35	150	Cooling
Colonial Process Co. 180 E. Union Ave.	24	12/28/68	85	400	30	67	Industrial
Howmedica Inc. 359 Veteran Blvd.	25	6/27/73	15	500	40	N/A	Industrial

TABLE 1 (Continued)

Owner and Address	Index No.	Date Drilled	Surface Elevation (ft)(MSL)	Well Depth (ft)	Static Water Level (ft)	Depth to Bedrock (ft)	Well Use
Top Notch Plating Co. Rt. 20	27	3/31/65	20	300	10	78	Industrial
Alpha Refining Co. Rt. 3	28	2/15/49	N/A	400	6	N/A	Unknown ⁽⁶⁾
Technical Oil Products 150 Grand St.	29	7/13/76	15	296	6	124	Cooling
Yoo-Hoo Beverage Co. 600 Commercial St.	30	4/20/65	10	278	10	N/A	Cooling
Yoo-Hoo Beverage Co. 600 commercial St.	31	5/1/64	10	298	10	N/A	Industrial
Yoo-Hoo Beverage Co. 600 Commercial St.	32	N/A	N/A	N/A	N/A	N/A	Non-contact Cooling
Compo Industries 170 W. Commercial Ave.	33	10/12/81	22	220	28	52	Cooling
J.E.S. Corp. 400 Veteran Blvd.	34	7/2/81	34	153	28	31	Industrial
Teaneck Chemical Co. 197 Washington Ave.	35	7/1/65	N/A	137	22	3	Industrial
Teaneck Chemical Co. 197 Washington Ave.	36	8/31/66	N/A	193	21	13	Industrial
Hermetite Div. Univ. Match 245 Paterson Plank Rd.	37	10/11/65	N/A	403	6	30	Industrial
Frank A. Rity	38 ⁽³⁾	N/A	N/A	N/A	N/A	N/A	Industrial
Little Ferry Alum. Foil	39 ⁽³⁾	N/A	N/A	N/A	N/A	N/A	Industrial
Atlantic Pipe	40 ⁽³⁾	N/A	N/A	N/A	N/A	N/A	Industrial
Carlton-Cooke Corp 456 Washington Ave.	41	9/6/54	500	255	15	N/A	Industrial
Record Electroplating 593 Broad St.	42	3/5/65	60	200	30	41	Industrial
J.J. Josephson Inc. 35 Empire Blvd.	43	6/23/75	10	500	62	N/A	Industrial
Stella Doro Co., Inc. Washington Ave.	44	12/27/65	N/A	120	12	N/A	Unknown ^{(4),(5)}
Insulating Fabricators 150 Union Ave.	45	8/31/64	30	300	60	62	Cooling
Ganes Chemical Works 611 Broad St.	46	2/9/48	80	826	44	53	Industrial
Ganes Chemical Works 611 Broad St	47	9/21/69	79	430	28	N/A	Industrial
Ganes Chemical Works 611 Broad St.	48	N/A	N/A	N/A	N/A	N/A	Industrial ⁽⁸⁾
Leo Van Der Wall Farm Road, Secaucus	49	12/26/51	N/A	200	5	163	Industrial
Old Mill Restaurant 300 Mill Ridge Rd, Secaucus	50	6/81	N/A	250	15	30	Domestic ^{(5),(7)}
Rutherford Investment Corp 320 Paterson Plank Rd	51	12/21/72	10	150	20	N/A	Cooling
Vestal Builders Highway South Rt.3, East Rutherford	52	8/20/54	N/A	130	15	95	Industrial
Lancaster Chemical Corp. Broad & 13th St.	53	12/28/63	0	400	68	223	Industrial
DuBois Chemical Union & Debois, E. Rutherford	54	12/20/80	N/A	305	4	N/A	Industrial
A & A Electroplating 443 Garden St.	55	7/20/77	95	375	32	N/A	Cooling and Industrial
Anders Chemical Co. 26 Poplar St., E. Rutherford	56	5/28/81	48	138	18	42	Industrial

TABLE 1 Continued

Owner and Address	Index No.	Date Drilled	Surface Elevation (ft)(MSL)	Well Depth (ft)	Static Water Level (ft)	Depth to Bedrock (ft)	Well Use
Lester Entin/DelSaco Foods 164 Madison St., E. Rutherford	57	11/2/70	N/A	300	10	130	Non-contact Cooling
Lester Entin Assoc. 164 Madison St., E. Rutherford	58	9/15/71	25	470	12	140	Cooling
Trubeck Laboratories Rt. 17, E. Rutherford	59	1/30/53	5	144	10	N/A	Industrial
Bellemead Development St. Hwy. S-3, E. Rutherford	60	9/17/48	N/A	416	10	330	Industrial

- Notes:**
- (1) The Hackensack Meadowlands Development Commission has indicated that no potable water wells exist in the area.
 - (2) Well numbers 7, 13 and 26 were deleted from the table because they were found to be more than 2 miles from the site. Furthermore, well number 13 has been closed.
 - (3) These wells could not be located on the map on Figure 5. The persons or companies are not listed within Bergen County. The well records are from historical NJDEP information.
 - (4) No response to telephone inquiry
 - (5) No response to certified letter survey
 - (6) Company not listed in Bergen County
 - (7) Listed customer of Hackensack Water Company
 - (8) Well is in bedrock

N/A - indicating that the information was not available in the well records

References: N.J. Dept. of Environmental Protection, Div. of Water Resources, Well Records, Carlstadt and Vicinity, N.J.

Hackensack Water Company

Hackensack Meadowlands Development Commission

TABLE 2

ORGANIC AND INORGANIC CHEMICAL COMPOUNDS DETECTED AT THE SCP SITE
(BASED ON SAMPLES COLLECTED BY DAMES & MOORE: JULY, DECEMBER, 1987)

Organic Chemical Compounds

Volatile Compounds

Benzene
Chlorobenzene
Chloroethane*
Chloroform
1,1 - Dichloroethane
1,2 - Dichloroethane
1,1 - Dichloroethylene
Ethylbenzene
Methylene chloride
1,1,2,2 - Tetrachloroethane
Tetrachloroethylene
Toluene
1,2-Trans-dichloroethylene
1,1,1 - Trichloroethane
1,1,2 - Trichloroethane
Trichloroethylene
Vinyl chloride
Methyl ethyl ketone
Styrene
m-Xylene
o+p -Xylenes

Acid Compounds

2-Chlorophenol
2,4 - Dichlorophenol
2,4 - Dimethylphenol
2 - Nitrophenol
Phenol

Base/Neutral Compounds

Acenaphthene
Acenaphthylene
Anthracene
Benzidine
Benzo (a) anthracene
Benzo (a) pyrene
Benzo (b) fluoranthene
Benzo (ghi) perylene
Benzo (k) fluoranthene
bis (2-Chloroethyl ether
bis (2-Ethyl hexyl) phthalate
Butyl benzyl phthalate
2 - Chloronaphthalene
Crysene
Dibenzo (a,h) anthracene
1,2 - Dichlorobenzene
1,3 - Dichlorobenzene
Diethyl phthalate
Dimethyl phthalate*

Di-n-butyl phthalate
Di-n-octyl phthalate
Fluoranthene
Fluorene
Indeno (1,2,3 - c,d) pyrene
Isophorone
Naphthalene
Nitrobenzene
N - Nitrosodiphenylamine
Phenanthrene
Pyrene
1,2,4 - Trichlorobenzene

Pesticide Compounds

Aldrin
Beta - BHC
4,4' - DDT
4,4'-DDE*
Dieldrin
Endosulfan I
Endrin
Endrin aldehyde*
Methoxychlor

PCB Aroclors

Aroclor 1242
Aroclor 1254
Aroclor 1260
Aroclor 1248
Aroclor 1232

Conventional Analysis Data

Phenolics, Total
Cyanide, Total
Petroleum Hydrocarbons

Inorganic Compounds

Metals

Antimony
Arsenic
Beryllium
Cadmium
Chromium
Copper
Lead
Mercury
Nickel
Selenium
Silver
Thallium
Zinc

NOTE:

*Detected only during the July
1987 sampling episode.

TABLE 3

MOBILITY PARAMETERS FOR ORGANIC CHEMICALS DETECTED
AT THE SCP SITE

Chemical	Vapor Pressure mm Hg @ 20°C	Water Solubility mg/l @ 20°C	Octanol/Water Partition Coefficient (log ₁₀)	Soil/Sediment Adsorption Coefficient (log ₁₀)	Specific Gravity (20°C)	Mobility Index
<u>Volatile Compounds</u>						
Benzene	76(1)	1780(1)	2.13(3)	1.99(5)	0.879(1)	3.1 Very mobile
Chlorobenzene	8.8(1)	500(1)	2.84(3)	2.25(7)	1.1066(1)	1.4 Very mobile
Chloroethane	1000(1)	5740(1)	1.54(3)	1.57(7)	0.92(1)	5.2 Extremely mobile
Chloroform	160(1)	8000(1)	1.97(3)	1.59(7)	1.489(1)	4.5 Very mobile
1,1-Dichloroethane	180(1)	5500(1)	1.79(3)	1.63(7)	1.174(1)	4.4 Very mobile
1,2-Dichloroethane	61(1)	8690(1)	1.48(3)	1.52(7)	1.25(1)	4.2 Very mobile
1,1-Dichloroethylene	500(1)	400(1)	1.48(2)	2.26(7)	1.218(1)	3.0 Very mobile
Ethyl benzene	7(1)	152(1)	3.15(3)	2.95(5)	0.867(1)	0.1 Very mobile
Methylene chloride	349(1)	20000(1)	1.25(3)	1.16(7)	1.326(2)	5.7 Extremely mobile
1,1,2-2-Tetrachloroethane	5(1)	2900(1)	2.56(3)	1.92(7)	1.60(1)	2.2 Very mobile
Tetrachloroethylene	14(1)	150(1)	2.88(3)	2.63(7)	1.626(1)	0.7 Very mobile
Toluene	22(1)	515(1)	2.69(3)	2.51(5)	0.867(1)	1.5 Very mobile
1,2-Trans-dichloroethylene	200(1)	600(1)	1.48(3)	1.17(7)	1.26(1)	2.9 Very mobile
1,1,1-Trichloroethane	100(1)	4400(1)	2.17(3)	1.75(7)	1.35(1)	3.9 Very mobile
1,1,2-Trichloroethane	19(1)	4500(1)	2.17(3)	1.75(7)	1.44(1)	3.2 Very mobile
Trichloroethylene	60(1)	1,100(1)	2.29(3)	3.76(7)	1.46(1)	1.1 Very mobile
Vinyl chloride	2660(1) @ 25°C	1,100(1) @ 25°C	0.60(3)	1.91(7)	0.912(1)	4.6 Very mobile
Methyl ethyl ketone	77.5(1)	3.53 x 10 ⁵ (1)	0.26(1)	0.59(6)	0.805(1)	6.9 Extremely mobile
Styrene	5(1)	300(1)	2.69(14)	2.62(9)	0.905(1)	0.6 Very mobile
Total Xylenes	6(1)	180(1)	3.02(1)	2.84(7)	0.864(1)	0.2 Very mobile
<u>Acid Compounds</u>						
2-Chlorophenol	5 @ 72°C(1)	26000(1)	8.52(3)	1.32(7)	1.245 @ 45°C(1)	3.8 Very mobile
2,4-Dichlorophenol	0.12(3)	4600(1)	2.75(3)	1.80(7)	1.383(1)	0.9 Very mobile
2,4-Dimethylphenol	0.06(3)	17000(3)	2.50(3)	2.34(5)	1.036(1)	0.7 Very mobile
2-Nitrophenol	20 @ 105°C(1)	2100(1)	1.76(3)	1.64(5)	1.657(1)	3.0 Very mobile
Phenol	0.2(1)	82000(1)	1.46(3)	1.36(5)	1.07(1)	2.9 Very mobile
<u>Base/Neutral Compounds</u>						
Acenaphthene	10 ⁻³ - 10 ⁻² (3)	3.4(3)	4.33(3)	4.05(5)	1.024(4)	-6.7 Immobile
Acenaphthylene	10 ⁻³ - 10 ⁻² (3)	3.9(3)	4.07(3)	3.81(5)	0.899(4)	-5.5 Immobile
Anthracene	2 x 10 ⁻³ (3)	0.075(1)	4.45(3)	4.16(5)	1.24(1)	-8.0 Immobile
Benidine	5 x 10 ⁻¹⁴ (11)	400 @ 12°C(1)	1.81(3)	1.69(5)	1.25(1)	-12 Immobile
Benzo(a)anthracene	5 x 10 ⁻⁹ (3)	0.01(3)	5.61(3)	5.25(5)	NA	-16 Immobile
Benzo(a)pyrene	5 x 10 ⁻⁹ (3)	0.004(3)	6.04(3)	5.65(5)	NA	-16 Immobile
Benzo(b)fluoranthene	10 ⁻¹¹ - 10 ⁻⁶ (3)	0.009(12)	6.57(3)	6.15(5)	NA	-14 Immobile
Benzo(ghi)perylene	10 ⁻¹⁰ (3)	3 x 10 ⁻⁴ (3)	7.23(3)	6.77(5)	NA	-20 Immobile
Benzo(k)fluoranthene	9.6 x 10 ⁻¹¹ (3)	0.0016(12)	6.84(3)	6.40(5)	NA	-19 Immobile
bis(2-Chloroethyl)ether	0.7(3)	10200(3)	1.58(3)	1.47(5)	1.220(4)	2.4 Very mobile
bis(2-Ethylhexyl)phthalate	2 x 10 ⁻⁷ (3)	0.4(3)	8.73(3)	8.17(5)	0.99(1)	-11 Immobile

TABLE 3 (continued)

Chemical	Vapor Pressure mm Hg @ 20°C	Water Solubility mg/l @ 20°C	Octanol/Water Partition Coefficient (log ₁₀)	Soil/Sediment Adsorption Coefficient (log ₁₀)	Specific Gravity (20°C)	Mobility Index
Base/Neutral Compounds						
Butyl benzyl phthalate	8.6 x 10 ⁻⁶ (1)	2.9(3)	5.8(3)	5.43(5)	1.1(1)	-10 Immobile
2-Chloronaphthalene	0.02(3)	6.7(3)	4.12(3)	NA	1.138(4)	NC
Chrysene	10 ⁻¹¹ - 10 ⁻⁶ (3)	0.002(3)	5.61(3)	5.25(5)	1.274(4)	-14 Immobile
Dibenzo(a,h)anthracene	10 ⁻¹⁰ (3)	5 x 10 ⁻⁴ (3)	5.97(3)	5.59(5)	NA	-20 Immobile
1,2-Dichlorobenzene	1.5(3)	100(1)	3.38(3)	2.70(7)	1.304(1)	-0.5 Slightly mobile
1,3-Dichlorobenzene	2.3(3)	123(1)	3.38(3)	2.65(7)	1.288(1)	-0.4 Slightly mobile
1,4-Dichlorobenzene	0.6(1)	79(1)	3.39(3)	2.76(7)	1.458(1)	-1.1 Slightly mobile
Diethyl phthalate	0.05(3)	1000(3)	3.22(3)	3.01(5)	1.12(1)	-1.3 Slightly mobile
Di-n-butyl phthalate	0.1(3)	13(3)	5.2(3)	4.87(5)	1.0465(1)	-4.8 Slightly mobile
Di-n-octyl phthalate	0.2(3)	3(3)	9.2(3)	8.61(5)	0.99(1)	-8.8 Immobile
Fluoranthene	10 ⁻⁶ - 10 ⁻⁴ (3)	0.3(3)	5.33(3)	4.99(5)	1.252(4)	-9.4 Immobile
Fluorene	10 ⁻³ - 10 ⁻² (3)	2(3)	4.18(3)	3.91(5)	1.203(4)	-6.7 Immobile
Indeno (1,2,3-c,d)pyrene	10 ⁻¹⁰ (3)	0.0034 @ 25°C(2)	7.66(3)	7.17(5)	NA	-19 Immobile
Isophorone	0.4(1)	12000(1)	1.7(3)	1.59(5)	0.92(1)	1.5 Very mobile
Naphthalene	0.5(3)	30(1)	3.37(3)	3.15(5)	1.152(1)	-2.0 Slightly mobile
Nitrobenzene	0.15(1)	1,900(1) (8,000 @ 80°C)(1)	1.85(3)	1.73(5)	1.20(1)	0.7 Very mobile
N-Nitrosodiphenylamine	0.007(11)	1100(12)	2.57(3)	2.40(5)	NA	-1.5 Slightly mobile
Phenanthrene	6.8 x 10 ⁻⁴ (3)	1.6(1)	4.46(3)	4.17(5)	1.025(1)	-7.1 Immobile
Pyrene	6.9 x 10 ⁻⁷ (3)	0.1(3)	5.32(3)	4.98(5)	1.271(1)	-12 Immobile
1,2,4-Trichlorobenzene	0.4(3)	30(3)	4.26(3)	3.04(7)	1.574(1)	-2.0 Slightly mobile
Pesticide Compounds						
Aldrin	7.5 x 10 ⁻⁵ (2)	0.017(3)	NA	4.61(6)	NA	NC
Beta-BHC	NA	NA	NA	NA	NA	NC
4,4'-DDT	1.5 x 10 ⁻⁷ (2)	0.006(3)	6.19(3)	4.86(6)	NA	-14 Immobile
4,4'-DDE	6.5 x 10 ⁻⁶ (3)	0.04(3)	5.69(3)	4.41(6)	NA	-11 Immobile
Dieldrin	3.1 x 10 ⁻⁶ (2)	0.2(3)	5.6(3)	4.02(6)	1.75(1)	-10 Immobile
Endosulfan I	1 x 10 ⁻⁵ (3)	0.5(3)	3.60(3)	3.81(6)	NA	-9 Immobile
Endrin	2 x 10 ⁻⁷ (2)	0.3(3)	5.6(3)	3.93(6)	NA	-11 Immobile
Endrin aldehyde	2 x 10 ⁻⁷ (3)	0.3(3)	5.6(3)	3.93(6)	NA	-11 Immobile
Methoxychlor	NA	NA	NA	NA	NA	NC
PCB-Aroclors						
Aroclor 1242	4.1 x 10 ⁻⁴ (3)	0.34(3)	4.11(3)	3.85(5)	1.35(3)	-7.7 Immobile
Aroclor 1254	7.7 x 10 ⁻⁵ (3)	0.056(3)	6.03(3)	5.64(5)	1.50(3)	-11 Immobile
Aroclor 1260	4.1 x 10 ⁻⁵ (3)	0.0027(3)	7.14(3)	6.68(5)	1.58(3)	-14 Immobile
Aroclor 1248	4.9 x 10 ⁻⁴ (3)	0.054(3)	5.75(3)	5.38(5)	1.41(3)	-10 Immobile
Aroclor 1232	4.1 x 10 ⁻³ (3)	1.5(3)	3.2(3)	2.99(5)	1.24(3)	-5.2 Immobile

TABLE 3 (continued)

NOTES:

1. Reference 12
2. Reference 11
3. Reference 13
4. Reference 14
5. Reference 10 - Equation 4.9: $\log K_{oc} = 0.937 \log K_{ow} - 0.006$
6. Reference 10 - Equation 4.5: $\log K_{oc} = -0.55 \log S + 3.64$ (S = water solubility in mg/l)
7. Reference 10 - Equation 4.7: $\log K_{oc} = -0.557 \log S + 4.277$ (S in u moles/l)
8. Average values for ortho, meta and para xylene
9. Average values for equations 4.6 ($\log K_{oc} = -0.54 \log S + 0.44$, S is mole fraction) and 4.10 ($\log K_{oc} = 1.00 \log K_{ow} - 0.21$)
10. Reference 10 - Equation 2.3
11. Reference 10 - Equation 14.20
12. Reference 10 - Equation 2.20
13. Reference 15
14. Reference 10 - Chapter 1
- NA. Not Available
- NC. Not Calculated

TABLE 4

CLASSIFICATION OF SILT/CLAY SOILS AT THE SCP SITE

Boring No.	Depth (Ft)	Moisture Content	Laboratory Classification	Liquid Limit	Plastic Limit	Placticity Index
RMW-2D	11-13	22.9	CL	25	17	8
	13-15	30.0	CL	45	25	20
	15-17	35.9	CL	53	23	30
	17-19	37.9	CL	45	17	28
	17-19.5	41.1	CL	38	18	20
	19-21	—	ML	—	—	NP
	21-23	—	ML	—	—	NP
RMW-4S	11-13	22.1	CL	27	18	9
RMW-5D	13-15	38.1	CL	46	21	25
	15-17	45.6	CL	44	19	25
	17-19	47.5	CH	51	23	28
	19-21.5	49.9	CL-CH	50	19	31
	21-23	48.3	CL	46	21	25
	23	12.6	CL	22	12	10
	23-25	—	ML	—	—	NP
RMW-7D	23-25	17.5	CL-ML	19	12	7
	11-13	24.8	CL-ML	27	20	7
	15-17.5	38.4	CL	39	22	17
	15-17.5	33.6	CL	39	22	17
	17-19	39.5	CL	41	20	21
	19-21	44.3	CL	44	20	24
	21-23	46.7	CL	49	21	28
	23-25	45.0	CL	45	21	24
	25-27.5	48.7	CL	46	19	27
	27-29	50.0	CL	46	20	26
	29-31	54.0	CH	53	21	32
	31-33	52.9	CH	51	20	31
	33-35.5	47.7	CL & CH	50	23	27
	35-37	16.0	CL	21	13	8
	39-41	15.9	CL & ML	22	15	7
RB-1	12-14	65.2	ML	—	—	NP
RB-2	9-11	26.1	CL & ML	25	19	6
RP-1	10-11	62.8	ML	—	—	NP
RP-2	11-13	24.3	CL & ML	22	17	5

NOTES:

NP - Not Plastic
 CL - Low Plasticity Clay
 CH - High Plasticity Clay
 ML - Silt

See Appendix A for a more detailed explanation of terminology (based on the Unified Soil Classification System).

TABLE 5
PERMEABILITY OF SILT/CLAY SOILS AT THE SCP SITE

<u>Boring No.</u>	<u>Depth (ft.)</u>	<u>Soil Type</u>	<u>K (cm/sec)</u>
MW-2D	11.5 - 13.5	ML	3.86×10^{-6}
RMW-2D	17.0 - 19.5	CL	4.96×10^{-8}
MW-5D	14.0 - 16.0	CL	4.35×10^{-8}
RMW-5D	19.0 - 21.5	CL	9.01×10^{-8}
RMW-7D	15.0 - 17.5	CL	1.49×10^{-7} (1) 1.85×10^{-7} (2)
MW-7D	18.0 - 20.0	CL	6.87×10^{-8}
RMW-7D	25.0 - 27.5	CL	8.62×10^{-8}
RMW-7D	33.0 - 35.5	CL-CH	1.18×10^{-7}

NOTES:

- (1) Permeability to distilled water
- (2) Permeability to site water (1.04 pore volumes)
- (3) See Appendix A for an explanation of soil type terminology.

TABLE 6

SOIL SAMPLES
OCCURRENCE OF CHEMICALS DETECTED AT THE SCP SITE
BASED ON SAMPLES COLLECTED BY DAMES & MOORE, DECEMBER 1987
(Values are in mg/kg)

CHEMICAL	NO. OF OCCURRENCES	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
<u>Volatile Compounds (68 samples)</u>					
Benzene	14	0.009	53.9	10.99	20.66
Chlorobenzene	14	0.012	336	67.961	112.079
Chloroform	16	0.004	379	80.55	126.92
1,1-Dichloroethane	8	0.005	179	37.358	62.155
1,2-Dichloroethane	15	0.015	290	42.78	79.62
1,1-Dichloroethylene	2	0.080	0.182	0.131	0.071
Ethylbenzene	31	0.019	652	76.93	155.83
Methylene chloride	43	0.009	124	10.35	24.07
1,1,2,2-Tetrachloroethane	3	0.032	0.7	0.341	0.338
Tetrachloroethylene	46	0.005	4290	325.99	802.72
Toluene	51	0.009	3380	300.57	649.247
1,2-Trans-dichloroethylene	19	0.003	512	53.208	134.41
1,1,1-Trichloroethane	12	0.023	1770	191.722	504.432
1,1,2-Trichloroethane	3	0.113	15.7	5.874	8.55
Trichloroethylene	43	0.029	2060	185.46	479.47
Vinyl chloride	1	0.028	0.028	0.028	--
Methyl ethyl ketone	27	0.018	795	38.322	154.99
Styrene	1	212	212	212	--
m-Xylene	42	0.012	2000	192.59	435.99
o + p-Xylenes	38	0.017	1450	138.86	298.22
<u>Acid Compound (58 samples)</u>					
2-Chlorophenol	1	0.238	0.238	0.238	--
2,4-Dichlorophenol	1	5.06	5.06	5.06	--
2,4-Dimethylphenol	6	0.146	10.8	3.812	4.651
Phenol	12	0.11	790	76.319	225.452
<u>Base/Neutral Compounds (58 samples)</u>					
Acenaphthene	18	0.072	21.2	2.177	4.875
Acenaphthylene	2	0.546	21	10.773	14.463
Anthracene	19	0.090	86.3	5.467	19.601
Benzidine	1	244	244	244	--
Benzo(a)anthracene	11	0.545	84.2	9.491	24.83
Benzo(a)pyrene	25	0.101	108	6.533	21.259
Benzo(b)fluoranthene	13	0.576	164	17.065	44.422
Benzo(ghi)perylene	13	0.227	73.3	7.57	19.861

TABLE 6 (continued)

CHEMICAL	NO. OF OCCURRENCES	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
<u>Base/Neutral Compounds (58 samples)</u>					
Benzo(k)fluoranthene	1	3.79	3.79	3.79	--
bis(2-Ethyl hexyl)phthalate	44	0.488	281	56.817	85.58
Butyl benzyl phthalate	17	0.524	861	12.622	25.514
2-Chloronaphthalene	5	0.131	122	28.356	52.906
Chrysene	20	0.116	106	7.054	23.336
Dibenzo(a,h)anthracene	3	0.499	2.4	1.04	1.037
1,2-Dichlorobenzene	21	0.085	47.3	24.10	15.497
1,3-Dichlorobenzene	1	0.962	0.962	0.962	--
1,4-Dichlorobenzene	2	0.381	1.83	1.105	1.024
Diethyl phthalate	1	5.09	5.09	5.09	--
Di-n-butyl phthalate	22	0.462	98.2	12.04	24.435
Di-n-octyl phthalate	15	0.557	19.5	5.392	5.157
Fluoranthene	36	0.086	176	7.404	26.092
Fluorene	20	0.087	94.1	6.034	20.686
Indeno (1,2,3-c,d)pyrene	12	0.213	86.9	10.123	24.436
Isophorone	4	0.151	.725	0.324	0.268
Naphthalene	39	0.077	480	18.881	77.659
Nitrobenzene	8	0.146	1350	200.45	467.97
N-Nitrosodiphenylamine	5	0.157	2.98	1.55	1.368
Phenanthrene	26	0.235	268	14.918	51.923
Pyrene	34	0.091	118	5.764	20.038
1,2,4-Trichlorobenzene	3	0.343	1.84	0.782	0.952
<u>Pesticide Compounds (58 samples)</u>					
Aldrin	4	0.14	57	14.655	28.233
Dieldrin	10	0.051	57	6.281	17.832
Methoxychlor	1	150	150	150	--
<u>PCB Aroclors (58 samples)</u>					
Aroclor 1242	37	0.017	15000	444.862	2496.033
Aroclor 1254	9	0.064	12	4.371	3.916
Aroclor 1260	6	0.043	48	11.84	18.255
Aroclor 1248	8	0.26	23	9.282	7.408
<u>Conventional Analysis Data (58 samples)</u>					
Phenolics, Total	48	0.1	683	39.358	129.159
Cyanide, Total	26	0.7	34	5.969	6.856
Petroleum Hydrocarbons	53	36	81600	7287.642	12577.376
<u>Metals (58 samples)</u>					
Antimony	8	6.9	38	15.712	11.594
Arsenic	44	1.1	62	11.529	14.413
Beryllium	58	0.23	57.6	1.553	7.492
Cadmium	43	0.28	132	13.828	25.477
Chromium	58	12	870	88.276	120.283
Copper	58	11	71600	3227.568	10121.28
Lead	55	8.6	2810	462.904	660.029
Mercury	42	0.084	21.3	2.465	4.479
Nickel	56	5.8	116	23.919	16.846
Selenium	9	0.88	4.9	1.942	1.377
Silver	9	1.2	40	8.444	13.155
Zinc	58	22	44400	1143.793	5813.004

TABLE 7

SOIL SAMPLES

VERTICAL DISTRIBUTION OF VOLATILE ORGANIC COMPOUNDS DETECTED AT THE SCP SITE
BASED ON 68 SAMPLES COLLECTED BY DAMES & MOORE
DECEMBER 1987
(VALUES ARE IN MG/KG)

VOLATILE ORGANIC COMPOUNDS⁽²⁾

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>
Unsaturated Fill	17/17	1,068	0.024 - 12,167
Saturated Fill	16/17	2,069	0.335 - 9,890
Top of Clay	15/17	153	0.042 - 1,822
Within Clay	17/17	361 ⁽¹⁾	0.048 - 4,124 ⁽¹⁾

NOTE:

- (1) The mean and range include the sample from RMW-7D, which had a total VOC concentration of 4,124 mg/kg. This value was more than 32 times greater than the next highest VOC concentration within the clay, and therefore may distort the mean value. This value occurred near the top of the clay, and the concentration decreased by an order of magnitude in the next sample down. Without this value included, the mean concentration is 126 mg/kg.
- (2) For breakdown by compound in each stratum, see Tables 7A through 7D.

TABLE 7A

**SOIL SAMPLES
VOLATILE ORGANIC COMPOUNDS IN THE UNSATURATED FILL
(Values are in Mg/Kg)**

<u>Compound</u>	<u>Occurrence/ Total Samples</u>	<u>Mean</u>	<u>Range</u>
Benzene	4/17	17.109	0.319 - 53.900
Chlorobenzene	4/17	113.538	0.282 - 336.000
Chloroform	4/17	10.348	0.004 - 17.800
1,1-Dichloroethane	2/17	37.900	11.100 - 64.700
1,2-Dichloroethane	4/17	4.845	0.016 - 10.200
1,1-Dichloroethylene	2/17	0.131	0.080 - 0.182
Ethylbenzene	7/17	168.223	0.038 - 652.000
Methylene chloride	11/17	0.607	0.009 - 2.390
1,1,2,2-Tetrachloroethane	1/17	0.288	0.288 - 0.288
Tetrachloroethylene	12/17	783.194	0.059 - 4290.000
Toluene	8/17	737.859	0.013 - 3380.000
1,2-Trans-dichloroethylene	5/17	0.078	0.004 - 0.241
1,1,1-Trichloroethane	1/17	2.490	2.490 - 2.490
1,1,2-Trichloroethane	2/17	0.962	0.113 - 1.810
Trichloroethylene	12/17	296.426	0.051 - 2060.000
Methyl ethyl ketone	2/17	8.576	0.019 - 8.560
m-Xylene	7/17	499.674	0.148 - 2000.000
o+p Xylenes	9/17	291.224	0.024 - 1450.000

TABLE 7B

SOIL SAMPLES
VOLATILE ORGANIC COMPOUNDS IN THE SATURATED FILL
(Values are in Mg/Kg)

Compound	Occurrence/ Total Samples	Mean	Range
Benzene	7/17	13.297	0.009 - 52.300
Chlorobenzene	6/17	73.042	0.012 - 258.000
Chloroform	3/17	166.933	39.600 - 379.000
1,1-Dichloroethane	3/17	74.044	0.031 - 179.000
1,2-dichloroethane	4/17	122.570	0.179 - 290.000
Ethylbenzene	15/17	96.840	0.028 - 529.000
Methylene chloride	8/17	4.114	0.020 - 14.900
1,1,2,2-Tetrachloroethane	1/17	0.703	0.703 - 0.703
Tetrachloroethylene	12/17	529.355	0.005 - 1690.000
Toluene	16/17	513.376	0.016 - 2410.000
1,2-Trans-dichloroethylene	5/17	189.030	0.023 - 512.000
1,1,1-Trichloroethane	3/17	648.133	30.400 - 1770.000
1,1,2-Trichloroethane	1/17	15.700	15.700 - 15.700
Trichloroethylene	8/17	415.271	0.097 - 1670.000
Vinyl chloride	1/17	0.029	0.029 - 0.029
Methyl ethyl ketone	5/17	171.468	0.021 - 795.000
m-Xylene	16/17	318.054	0.023 - 1580.000
o+p-Xylenes	16/17	196.136	0.025 - 710.000

TABLE 7C

SOIL SAMPLES
VOLATILE ORGANIC COMPOUNDS IN THE TOP OF CLAY
(Values are in Mg/Kg)

Compound	Occurrence/ Total Samples	Mean	Range
Benzene	3/17	0.448	0.052 - 1.010
Chlorobenzene	1/17	0.115	0.115 - 0.115
Chloroform	3/17	95.886	0.566 - 234.000
1,1-Dichloroethane	2/17	0.120	0.006 - 0.234
1,2-Dichloroethane	4/17	3.236	0.110 - 6.500
Ethylbenzene	7/17	10.564	0.027 - 45.600
Methylene chloride	8/17	5.251	0.015 - 20.800
1,1,2,2-Tetrachloroethane	1/17	0.032	0.032 - 0.032
Tetrachloroethylene	7/17	205.656	0.133 - 917.000
Toluene	13/17	30.490	0.010 - 216.000
1,2-Trans-dichloroethylene	7/17	3.652	0.022 - 12.200
1,1,1-Trichloroethane	2/17	30.730	3.860 - 57.600
Trichloroethylene	6/17	92.052	0.045 - 363.000
Styrene	1/17	0.212	0.212 - 0.212
Methyl ethyl ketone	11/17	5.953	0.029 - 31.500
m-Xylene	9/17	25.599	0.013 - 135.000
o_p-Xylenes	8/17	20.230	0.079 - 87.900

TABLE 7D

SOIL SAMPLES
VOLATILE ORGANIC COMPOUNDS WITHIN THE CLAY
(Values are in Mg/Kg)

Compound	Occurrence/ Total Samples	Mean	Range
Chlorobenzene	2/17	29.510	6.720 - 52.300
2-Chloroethylvinyl ether	3/17	5.100	4.360 - 5.530
Chloroform	3/17	166.004	0.011 - 333.000
1,1-Dichloroethane	1/17	0.698	0.698 - 0.698
1,2-Dichloroethane	3/17	42.100	3.700 - 69.900
Ethylbenzene	2/17	51.010	0.020 - 102.000
Methylene chloride	16/17	23.439	0.048 - 124.000
Tetrachloroethylene	15/17	68.671	0.020 - 785.000
Toluene	14/17	58.409	0.010 - 715.000
1,2-Trans-dichloroethylene	2/17	22.390	6.580 - 38.200
1,1,1-Trichloroethane	6/17	48.821	0.024 - 287.000
Trichloroethylene	17/17	125.614	0.029 - 1560.000
Methyl ethyl ketone	9/17	11.476	0.030 - 69.000
m-Xylene	10/17	47.589	0.015 - 287.000
o+p-Xylene	6/17	46.323	0.017 - 173.000

TABLE 8

SOIL SAMPLES

VERTICAL DISTRIBUTION OF BASE/NEUTRAL COMPOUNDS DETECTED AT THE SCP SITE
BASED ON 58 SAMPLES COLLECTED BY DAMES & MOORE
DECEMBER 1987
(VALUES ARE IN MG/KG)

BASE/NEUTRAL COMPOUNDS(3)

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>
Unsaturated Fill	17/17	147	23 - 447
Saturated Fill	16/17	343 ⁽¹⁾	1.2 - 3,913 ⁽¹⁾
Top of Clay	16/17	20 ⁽²⁾	1.0 - 174
Within Clay	5/7	0.46	0.17 - 1.2

NOTES:

- (1) The mean and range include the sample from RMW-3S, which represents the maximum value at this depth (3,913 mg/kg). This concentration is more than 9 times greater than the next highest value at this depth, and nearly 9 times greater than the next highest value at any other depth. Without this value included, the mean is 105 mg/kg.
- (2) The mean value includes the peak concentration of 174 mg/kg from boring RP-4. This value is more than 4 times greater than the next highest concentration at this depth. Without this value included, the mean concentration is 9.7 mg/kg.
- (3) For breakdown by compound in each stratum, see Tables 8A through 8D.

TABLE 8A

SOIL SAMPLES
BASE/NEUTRAL COMPOUNDS IN THE UNSATURATED FILL
(Values are in Mg/Kg)

Compound	Occurrence/ Total Samples	Mean	Range
Acenaphthene	9/17	1.317	0.0856 - 3.780
Acenaphthylene	1/17	0.546	0.546 - 0.546
Anthracene	9/17	1.272	0.117 - 3.910
Benzo(a)anthracene	5/17	2.394	1.270 - 4.540
Benzo(a)pyrene	9/17	3.104	1.000 - 9.390
Benzo(b)fluoranthene	6/17	7.002	2.070 - 17.700
Benzo(ghi)perylene	7/17	2.792	0.891 - 6.950
Benzo(k)fluoranthene	1/17	3.790	3.790 - 3.790
bis(2-Ethylhexyl)phthalate	17/17	77.082	4.570 - 281.000
Butyl benzyl phthalate	8/17	13.966	0.524 - 86.100
2-Chloronaphthalene	2/17	61.066	0.131 - 122.000
4-Chlorophenyl phenyl ether	1/17	2.600	2.600 - 2.600
Chrysene	11/17	2.035	0.499 - 5.500
Dibenzo(a,h)anthracene	2/17	1.566	0.731 - 2.400
1,2-Dichlorobenzene	8/17	12.907	0.137 - 47.300
1,3-Dichlorobenzene	1/17	0.962	0.962 - 0.962
1,4-Dichlorobenzene	2/17	1.106	0.381 - 1.830
Diethyl phthalate	1/17	5.090	5.090 - 5.090
Di-n-butyl phthalate	13/17	9.998	0.462 - 71.000
Di-n-octyl phthalate	6/17	5.022	1.220 - 9.050
Fluoranthene	16/17	3.476	0.245 - 15.300
Fluorene	9/17	2.179	0.111 - 11.000
Indeno(1,2,3-c,d)pyrene	7/17	4.057	1.140 - 12.100
Naphthalene	16/17	9.378	0.141 - 102.000
Nitrobenzene	1/17	117.000	117.000 - 117.000
N-Nitrosodiphenylamine	3/17	1.807	0.162 - 2.980
Phenanthrene	13/17	6.331	0.224 - 23.600
Pyrene	15/17	3.329	0.392 - 12.700
1,2,4-Trichlorobenzene	2/17	1.017	0.343 - 1.690

TABLE 8B

SOIL SAMPLES
BASE/NEUTRAL COMPOUNDS IN THE SATURATED FILL
(Values are in Mg/Kg)

Compound	Occurrence/ Total Samples	Mean	Range
Acenaphthene	8/17	3.406	0.0728 - 21.200
Acenaphthylene	1/17	21.000	21.000 - 21.000
Anthracene	7/17	13.143	0.205 - 86.300
Benzidine	1/17	244.000	244.000 - 244.000
Benzo(a)anthracene	5/17	18.375	0.545 - 84.200
Benzo(a)pyrene	7/17	16.985	0.130 - 108.000
Benzo(b)fluoranthene	6/17	29.879	0.871 - 164.000
Benzo(ghi)perylene	5/17	15.729	0.301 - 73.300
bis(2-Ethylhexyl)phthalate	14/17	77.435	0.989 - 381.000
Butyl benzyl phthalate	6/17	16.175	1.020 - 73.600
2-Chloronaphthalene	3/17	6.550	0.289 - 18.200
Chrysene	7/17	16.580	0.179 - 106.000
1,2-Dichlorobenzene	6/17	65.078	0.244 - 385.000
Di-n-butyl phthalate	6/17	18.769	0.635 - 98.200
Di-n-octyl phthalate	5/17	8.459	0.557 - 19.500
Fluoranthene	13/17	15.873	0.113 - 176.000
Fluorene	9/17	11.200	0.127 - 94.100
Indeno(1,2,3-c,d)pyrene	4/17	23.218	0.396 - 86.900
Naphthalene	14/17	41.255	0.127 - 480.000
Nitrobenzene	1/17	1350.000	1350.000 - 1350.000
N-Nitrosodiphenylamine	1/17	0.157	0.157 - 0.157
Phenanthrene	9/17	33.411	0.576 - 268.000
Pyrene	12/17	11.855	0.0924 - 118.000
1,2,4-Trichlorobenzene	1/17	0.350	0.350 - 0.350

TABLE 8C

SOIL SAMPLES
BASE/NEUTRAL COMPOUNDS IN THE TOP OF CLAY
(Values are in Mg/Kg)

Compound	Occurrence/ Total Samples	Mean	Range	
Acenaphthene	1/17	0.10	0.100	- 0.100
Anthracene	2/17	0.13	0.091	- 0.164
Benzo(a)anthracene	1/17	0.56	0.564	- 0.564
Benzo(a)pyrene	10/17	1.69	0.101	- 4.740
Benzo(b)fluoranthene	1/17	0.58	0.576	- 0.576
Benzo(ghi)perylene	1/17	0.23	0.227	- 0.227
bis(2-Ethylhexyl)phthalate	13/17	8.11	0.448	- 33.600
Butyl benzyl phthalate	3/17	2.16	0.714	- 4.690
Chrysene	3/17	0.63	0.116	- 1.340
1,2-Dichlorobenzene	5/17	2.48	0.085	- 10.800
Di-n-butyl phthalate	3/17	1.92	0.887	- 2.440
Di-n-octyl phthalate	4/17	2.11	0.771	- 5.610
Fluoranthene	7/17	0.66	0.086	- 2.320
Fluorene	2/17	0.14	0.087	- 0.186
Indeno(1,2,3-c,d)pyrene	1/17	0.21	0.213	- 0.213
Isophorone	3/17	0.38	0.203	- 0.725
Naphthalene	9/17	0.97	0.077	- 2.270
Nitrobenzene	1/17	135.00	135.000	- 135.000
N-Nitrosodiphenylamine	1/17	0.20	0.200	- 0.200
Phenanthrene	4/17	1.22	0.235	- 3.250
Pyrene	6/17	0.64	0.091	- 1.840

TABLE 8D

SOIL SAMPLES
BASE/NEUTRAL COMPOUNDS WITHIN THE CLAY
(Values are in Mg/Kg)

<u>Compound</u>	<u>Occurrence/ Total Samples</u>	<u>Mean</u>	<u>Range</u>
1,2-Dichlorobenzene	2/7	0.286	0.107 - 0.465
Isophorone	1/7	0.151	0.151 - 0.151
Nitrobenzene	5/7	0.320	0.146 - 0.718

TABLE 9

SOIL SAMPLES

VERTICAL DISTRIBUTION OF ACID EXTRACTABLE COMPOUNDS DETECTED AT THE SCP SITE
BASED ON 58 SAMPLES COLLECTED BY DAMES & MOORE
DECEMBER 1987
(VALUES ARE IN MG/KG)

ACID EXTRACTABLE COMPOUNDS⁽²⁾

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>
Unsaturated Fill	6/17	12	0.146 - 58.2
Saturated Fill	5/17	169 ⁽¹⁾	0.110 - 801 ⁽¹⁾
Top of Clay	3/17	9.2	0.930 - 23.0
Within Clay	2/7	0.336	0.238 - 0.434

NOTES:

- (1) The mean and range include the sample from RB-1, which had a concentration of 801 mg/kg. This value is more than 21 times greater than the next highest AEC concentration at this depth, and is believed to be related to the sludge pit present at the location of boring RB-1. Without this value included, the mean concentration is 11 mg/kg.
- (2) For breakdown by compound in each stratum, see Table 9A.

TABLE 9A

SOIL SAMPLES
ACID EXTRACTABLE COMPOUNDS BY STRATUM
(Values are in mg/kg)

UNSATURATED FILL

<u>Compound</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>
2,4-Dichlorophenol	1/17	5.06	-- - --
2,4-Dimethylphenol	2/17	0.63	0.146 - 1.12
Phenol	4/17	16.30	0.858 - 58.20

SATURATED FILL

<u>Compound</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>
2,4-Dimethylphenol	3/17	4.30	0.290 - 10.80
Phenol	4/17	208.00	0.858 - 790.00

TOP OF CLAY

<u>Compound</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>
2,4-Dimethylphenol	1/17	8.58	-- - --
Phenol	3/17	6.30	0.930 - 14.40

WITHIN CLAY

<u>Compound</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>
2-Chlorophenol	1/17	0.238	-- - --
Phenol	1/17	0.434	-- - --

TABLE 10

SOIL SAMPLES

VERTICAL DISTRIBUTION OF PESTICIDE COMPOUNDS DETECTED AT THE SCP SITE
BASED ON 58 SAMPLES COLLECTED BY DAMES & MOORE
DECEMBER 1987
(VALUES ARE IN MG/KG)

ALDRIN

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>
Unsaturated Fill	3/17	19.1	0.280 - 57
Saturated Fill	1/17	1.2	-- - --
Top of Clay	0/17	--	-- - --
Within Clay	0/7	--	-- - --

DIELDRIN

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>
Unsaturated Fill	5/17	12.1	0.460 - 57
Saturated Fill	3/17	0.61	0.051 - 0.940
Top of Clay	2/17	0.12	0.025 - 0.210
Within Clay	0/7	--	-- - --

METHOXYCHLOR

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>
Unsaturated Fill	0/17	--	--
Saturated Fill	1/17	--	--
Top of Clay	0/17	--	--
Within Clay	0/17	--	--

NOTE:

Methoxychlor, at 150 mg/kg, was detected in one sample in the saturated fill.

TABLE 11

SOIL SAMPLES

VERTICAL DISTRIBUTION OF PCBs DETECTED AT THE SCP SITE
BASED ON 58 SAMPLES COLLECTED BY DAMES & MOORE
DECEMBER 1987
(VALUES ARE IN MG/KG)

PCBs(2)

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>
Unsaturated Fill	15/17	1,048 ⁽¹⁾	0.33 - 15,000 ⁽¹⁾
Saturated Fill	15/17	62	0.08 - 350
Top of Clay	13/17	1.8	0.017 - 5.4
Within Clay	3/7	0.19	0.082 - 0.370

NOTES:

(1) The mean and range include the sample from RB-1, which had a concentration of 15,000 mg/kg. This value is more than 37 times greater than the next highest PCB concentration at this or any other depth, and is believed to be related to the sludge pit present at the location of boring RB-1. Without this value included, the mean concentration is 51 mg/kg.

(2) For breakdown by quantified Aroclors, see Table 11A.

TABLE 11A

SOIL SAMPLES
PCB BY STRATUM
(Values are in mg/kg)

UNSATURATED FILL

<u>PCB Aroclor⁽¹⁾</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>
1242	11/17	1,416.00	0.330 - 15,000.00
1254	4/17	7.80	4.100 - 12.00
1260	2/17	29.00	9.900 - 48.00
1248	4/17	13.50	4.100 - 23.00

SATURATED FILL

<u>PCB Aroclor⁽¹⁾</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>
1242	12/17	72.60	0.080 - 350.00
1254	3/17	2.00	0.180 - 3.50
1260	2/17	6.10	2.100 - 10.00
1248	2/17	8.70	7.600 - 9.70

TOP OF CLAY

<u>PCB Aroclor⁽¹⁾</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>
1242	11/17	1.60	0.017 - 5.40
1254	2/17	1.10	0.164 - 2.20
1260	2/17	0.52	0.043 - 1.00
1248	2/17	0.14	0.260 - 2.60

WITHIN CLAY

<u>PCB Aroclor⁽¹⁾</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>
1242	3/17	0.19	0.082 - 0.37
1254	0/17	—	— - —
1260	0/17	—	— - —
1248	0/17	—	— - —

NOTE: ⁽¹⁾PCB quantified as the Aroclors listed.

TABLE 12

SOIL SAMPLES

VERTICAL DISTRIBUTION OF TOTAL CYANIDES DETECTED AT THE SCP SITE
 BASED ON 58 SAMPLES COLLECTED BY DAMES & MOORE
 DECEMBER 1987
 (VALUES ARE IN MG/KG)

TOTAL CYANIDES

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>	
Unsaturated Fill	16/17	4.7	0.7	- 34
Saturated Fill	9/17	8.5	0.9	- 32
Top of Clay	1/17	3.5	--	- --
Within Clay	0/7	--	--	- --

TABLE 13

SOIL SAMPLES

VERTICAL DISTRIBUTION OF TOTAL PHENOLICS DETECTED AT THE SCP SITE
BASED ON 58 SAMPLES COLLECTED BY DAMES & MOORE
DECEMBER 1987
(VALUES ARE IN MG/KG)

TOTAL PHENOLICS

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>	
Unsaturated Fill	16/17	50 ⁽¹⁾	0.2	- 600 ⁽¹⁾
Saturated Fill	15/17	66 ⁽²⁾	1.5	- 683 ⁽²⁾
Top of Clay	14/17	6.6	0.1	- 65
Within Clay	3/7	1.5	1.4	- 1.6

NOTES:

- (1) The mean and range include the sample from RB-1, which had a concentration of 600 mg/kg. This value is 8 times greater than the next highest concentration in the unsaturated fill, and is believed to be related to the sludge pit present at the location of boring RB-1. Without this value included, the mean concentration is 13.7 mg/kg.
- (2) The mean and range include the sample from RB-1, which had a concentration of 683 mg/kg. This value is more than 5 times greater than the next highest concentration in the saturated fill, and is believed to be related to the sludge pit present at the location of boring RB-1. Without this value included, the mean concentration is 21.7 mg/kg.

TABLE 14

SOIL SAMPLES

VERTICAL DISTRIBUTION OF TOTAL PETROLEUM HYDROCARBONS DETECTED AT THE SCP SITE
BASED ON 58 SAMPLES COLLECTED BY DAMES & MOORE
DECEMBER 1987
(VALUES ARE IN MG/KG)

TOTAL PETROLEUM HYDROCARBONS

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>	
Unsaturated Fill	17/17	13,167	290	- 81,600
Saturated Fill	17/17	8,507	36	- 29,600
Top of Clay	15/17	1,164	51	- 5,780
Within Clay	4/7	82.5	52	- 102

TABLE 15

SOIL SAMPLES

VERTICAL DISTRIBUTION OF METALS DETECTED AT THE SCP SITE
 BASED ON 58 SAMPLES COLLECTED BY DAMES & MOORE
 DECEMBER 1987
 (VALUES ARE IN MG/KG)

ANTIMONY (OVERALL MEAN = 16)

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>
Unsaturated Fill	3/17	12	9.2 - 16
Saturated Fill	4/17	15	6.9 - 38
Top of Clay	1/17	29	-- - --
Within Clay	0/7	--	-- - --

ARSENIC (OVERALL MEAN = 12)

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>
Unsaturated Fill	14/17	14	2.7 - 60
Saturated Fill	15/17	16	1.2 - 62
Top of Clay	10/17	5.7	1.1 - 18
Within Clay	5/7	3.1	1.1 - 5.5

BERYLLIUM (OVERALL MEAN = 1.6)

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>
Unsaturated Fill	17/17	3.8 ⁽¹⁾	0.23 - 57.6 ⁽¹⁾
Saturated Fill	17/17	0.54	0.23 - 1.30
Top of Clay	17/17	0.50	0.30 - 0.74
Within Clay	7/7	1.00	0.59 - 1.15

CADMIUM (OVERALL MEAN = 14)

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>
Unsaturated Fill	17/17	15	1.00 - 95.1
Saturated Fill	16/17	10	0.32 - 26
Top of Clay	9/17	19 ⁽²⁾	0.52 - 132 ⁽²⁾
Within Clay	1/7	0.28	-- - --

TABLE 15 (continued)

CHROMIUM (OVERALL MEAN = 88)

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>	
Unsaturated Fill	17/17	171	19	- 870
Saturated Fill	17/17	92	12	- 542
Top of Clay	17/17	22	12	- 56
Within Clay	7/7	28	17	- 33

COPPER (OVERALL MEAN = 3,228)

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>	
Unsaturated Fill	17/17	8,788	315	- 71,600
Saturated Fill	17/17	1,425	32	- 8,600
Top of Clay	17/17	786 ⁽³⁾	11	- 11,900 ⁽³⁾
Within Clay	7/17	30	15	- 39

LEAD (OVERALL MEAN = 465)

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>	
Unsaturated Fill	17/17	667	140	- 2,750
Saturated Fill	17/17	735	18	- 2,810
Top of Clay	15/17	111	8.6	- 916
Within Clay	6/7	12	9.6	- 17

MERCURY (OVERALL MEAN = 2.5)

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>	
Unsaturated Fill	17/17	3.3	0.4	- 21.3
Saturated Fill	16/17	2.0	0.14	- 13.6
Top of Clay	9/17	1.8 ⁽⁴⁾	0.084	- 13.6 ⁽⁴⁾
Within Clay	0/7	—	—	—

TABLE 15 (continued)

NICKEL (OVERALL MEAN = 24)

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>	
Unsaturated Fill	15/17	21	10	- 39
Saturated Fill	17/17	31	8.5	- 116
Top of Clay	17/17	16	5.8	- 44
Within Clay	7/7	31	18	- 37

SELENIUM (OVERALL MEAN = 1.9)

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>	
Unsaturated Fill	5/17	2.3	0.88	- 4.9
Saturated Fill	3/17	1.6	1.0	- 2.1
Top of Clay	1/17	1.3	--	- --
Within Clay	0/7	--	--	- --

SILVER (OVERALL MEAN = 8.4)

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>	
Unsaturated Fill	7/17	5.0	1.2	- 6.4
Saturated Fill	1/17	40	--	- --
Top of Clay	1/17	1.2	--	- --
Within Clay	0/7	--	--	- --

ZINC (OVERALL MEAN = 1,144)

<u>Stratum</u>	<u>Occurrence/Total Samples</u>	<u>Mean</u>	<u>Range</u>	
Unsaturated Fill	17/17	623	130	- 4,170
Saturated Fill	17/17	564	67	- 1,870
Top of Clay	17/17	2685 ⁽⁵⁾	22	- 44,400 ⁽⁵⁾
Within Clay	7/7	73	42	- 87

TABLE 15 (continued)

NOTES:

- (1) The mean and range include the sample from RMW-5D, which had a beryllium concentration of 57.6 mg/kg. This value was more than 66 times greater than the next highest beryllium concentration in the unsaturated fill, and therefore, substantially distorts the mean value. Without this value included, the mean concentration is 0.49 mg/kg.
- (2) The mean and range include the sample from RB-1, which had a cadmium concentration of 132 mg/kg. This value was more than 5 times greater than the next highest cadmium concentration at the top of clay, and is believed to be related to the sludge pit present at the location of boring RB-1. Without this value included, the mean concentration is 4.5 mg/kg.
- (3) The mean and range include the sample from RB-1, which had a copper concentration of 11,900 mg/kg. This value was more than 26 times greater than the next highest copper concentration at the top of clay, and is believed to be related to the sludge pit present at the location of boring RB-1. Without this value included, the mean concentration is 91 mg/kg.
- (4) The mean and range include the sample from RP-3, which had a mercury concentration of 13.6 mg/kg. This value was more than 215 times greater than the next highest mercury concentration at the top of clay, and therefore, substantially distorts the mean value. Without this value included, the mean concentration is 0.34 mg/kg.
- (5) The mean and range include the sample from RP-3, which had a zinc concentration of 44,400 mg/kg. This value was more than 192 times greater than the next highest zinc concentration at the top of clay, and therefore, substantially distorts the mean value. Without this value included, the mean concentration is 78 mg/kg.

TABLE 16

HYDROLOGIC PARAMETERS
WATER TABLE AQUIFER
SCP SITE

Well No.	PERMEABILITY (cm/sec)				TRANSMISSIVITY (ft ² /sec)			
	Falling Head		Rising Head		Falling Head		Rising Head	
	Cooper	Bower	Cooper	Bower	Cooper	Bower	Cooper	Bower
MW-1S	6.3 E-3	7.34 E-4	1.4 E-2	8.05 E-3	1.374 E-3	1.61 E-4	3.185 E-3	1.77 E-3
MW-2S	5.9 E-4	7.36 E-4	2.0 E-3	1.46 E-3	8.202 E-5	1.02 E-4	2.899 E-4	4.78 E-5
MW-3S	1.1 E-4	7.98 E-5	1.2 E-4	4.02 E-4	3.924 E-5	3.14 E-5	4.808 E-5	1.58 E-4
MW-4S	3.8 E-3	1.82 E-3	2.3 E-3	1.36 E-3	4.271 E-4	4.46 E-5	6.591 E-4	5.99 E-5
MW-5S	5.8 E-2	1.69 E-2	2.4 E-2	3.56 E-2	7.803 E-3	2.25 E-3	3.244 E-3	4.74 E-3
MW-6S	2.3 E-3	1.05 E-3	6.2 E-3	2.47 E-3	3.102 E-4	1.41 E-4	8.336 E-4	3.32 E-4
MW-7S	8.2 E-5	6.35 E-5	1.7 E-4	1.74 E-4	1.542 E-5	1.19 E-5	3.109 E-5	3.26 E-5

NOTE: E-3 = 10⁻³, etc.

TABLE 17

PHYSICOCHEMICAL PARAMETERS
WATER TABLE AQUIFER
SCP SITE

Well No.	Temperature (°C)		pH (Standard Units)		Conductivity (umhos/cm)	
	July 1987	December 1987	July 1987	December 1987	July 1987	December 1987
MW-1S	24.2	9	6.92	6.23	5330	3620
MW-2S	25.1	9	8.93	6.93	7320	5620
MW-3S	17.8	9	6.26	6.28	3080	1839
MW-4S	29.1	8	6.57	6.32	8090	7330
MW-5S	24.3	9	6.62	6.48	1562	1621
MW-6S	26.5	7	6.88	6.67	2030	1602
MW-7S	23.2	12	6.74	7.45	16070	13790

TABLE 18

WATER TABLE AQUIFER SAMPLES
 OCCURRENCE OF CHEMICALS DETECTED AT THE SCP SITE
 BASED ON SAMPLES COLLECTED BY DAMES & MOORE, JULY 1987
 (Values are in mg/l)

<u>CHEMICAL</u>	<u>NO. OF OCCURRENCES</u>	<u>MINIMUM</u>	<u>MAXIMUM</u>	<u>MEAN</u>	<u>STANDARD DEVIATION</u>
<u>Volatile Compounds</u>					
Benzene	5/7	0.673	6.83	2.947	2.812
Chlorobenzene	1/7	6.56	6.56	6.56	--
Chloroethane	1/7	2.42	2.42	2.42	--
Chloroform	3/7	0.605	614	207.021	352.465
1,1-Dichloroethane	5/7	0.528	11.7	4.461	4.95
1,2-Dichloroethane	2/7	16.3	396	206.15	268.488
Ethyl Benzene	2/7	0.45	3.9	2.175	2.439
Methylene Chloride	6/7	0.033	200	62.136	93.559
1,1,2,2-Tetrachloroethane	1/7	3.05	3.05	3.05	--
Tetrachloroethylene	1/7	17.9	17.9	17.9	--
Toluene	7/7	0.12	60	25.275	21.675
1,2-Trans-dichloroethylene	6/7	0.326	64.7	21.487	24.553
1,1,1-Trichloroethane	3/7	12.3	45.6	31.7	17.317
Trichloroethylene	3/7	15.6	161	103.866	77.538
Vinyl chloride	5/7	0.248	6.81	3.773	2.706
Methyl ethyl ketone	3/7	8.86	2000	694.953	1130.702
m-Xylene	3/7	1.55	20.4	8.006	10.736
o + p-Xylenes	4/7	0.257	15.2	4.594	7.098
<u>Acid Compounds</u>					
2,4-Dichlorophenol	1/7	0.235	0.235	0.235	--
2,4-Dimethyl phenol	5/7	0.00679	0.736	0.286	0.29
Phenol	7/7	0.0392	17.1	3.549	6.146
<u>Base/Neutral Compounds</u>					
Acenaphthene	2/7	0.00289	0.00637	0.00463	0.00246
Acenaphthylene	1/7	0.00633	0.00633	0.00633	--

TABLE 18 (Continued)

CHEMICAL	NO. OF OCCURRENCES	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION
<u>Base/Neutral Compounds</u>					
bis(2-Chloroethyl) ether	1/7	1.26	1.26	1.26	--
bis(2-Ethyl hexyl) phthalate	2/7	0.0255	0.654	0.339	0.444
Butyl benzyl phthalate	1/7	0.0104	0.0104	0.0104	--
2-Chloronaphthalene	1/7	0.0189	0.0189	0.0189	--
1,2-Dichlorobenzene	6/7	0.00933	0.192	0.0066	0.065
Diethyl phthalate	1/7	0.0152	0.0152	0.0152	--
Dimethyl phthalate	1/7	0.316	0.316	0.316	--
Di-n-butyl phthalate	1/7	0.0129	0.0129	0.0129	--
Fluoranthene	2/7	0.00253	0.00372	0.00312	0.00084
Fluorene	1/7	0.00649	0.00649	0.00649	--
Isophorone	2/7	0.463	8.45	4.456	5.647
Naphthalene	7/7	0.0156	0.248	0.06108	0.0847
Nitrobenzene	2/7	29.4	57.9	43.65	20.152
Phenanthrene	1/7	0.0112	0.0112	0.0112	--
<u>Pesticide Compounds</u>					
4,4'-DDT	1/7	0.000369	0.000369	0.000369	--
4,4'-DDE	1/7	0.00059	0.00059	0.00059	--
Endrin aldehyde	2/7	0.00102	0.015	0.00801	0.00988
<u>PCB Aroclors</u>					
Aroclor 1242	3/7	0.0018	0.233	0.116	0.115
<u>Conventional Analysis Data</u>					
Phenolics, Total	7/7	0.062	42.5	10.018	15.355
Cyanide, Total	4/7	0.03	3.64	0.946	1.795
Petroleum Hydrocarbons	6/7	4.3	2270	422.15	910.095
<u>Metals</u>					
Arsenic	3/7	0.021	0.19	0.074	0.077
Chromium	1/7	0.032	0.320	0.320	--
Copper	4/7	0.014	0.060	0.0285	0.0215
Mercury	1/7	0.00021	0.00021	0.00021	--
Nickel	5/7	0.022	0.15	0.0628	0.0505
Silver	1/7	0.110	0.110	0.110	--
Zinc	4/7	0.034	0.690	0.243	0.301

TABLE 19

WATER TABLE AQUIFER SAMPLES
OCCURRENCE OF CHEMICALS DETECTED AT THE SCP SITE
BASED ON SAMPLES COLLECTED BY DAMES & MOORE, DECEMBER 1987
(Values are in mg/l)

<u>CHEMICAL</u>	<u>NO. OF OCCURRENCES</u>	<u>MINIMUM</u>	<u>MAXIMUM</u>	<u>MEAN</u>	<u>STANDARD DEVIATION</u>
<u>Volatile Compounds</u>					
Benzene	5/7	0.568	7.27	3.939	3.065
Chlorobenzene	2/7	0.121	4.020	2.07	2.757
Chloroform	1/7	595	595	595	--
1,1-Dichloroethane	3/7	0.138	1.84	0.775	0.928
1,2-Dichloroethane	2/7	0.089	473	236.544	334.398
1,1-Dichloroethylene	1/7	0.4	0.4	0.4	--
Ethyl benzene	4/7	0.404	3.57	1.946	1.744
Methylene chloride	4/7	0.0349	132	46.598	62.018
1,1,2,2- Tetrachloroethane	3/7	0.116	7.35	4.848	4.1
Tetrachloroethylene	2/7	8.24	24.5	16.37	11.497
Toluene	7/7	0.097	90.9	28.373	32.618
1,2-Trans-dichloroethylene	6/7	1.14	31.1	12.76	13.931
1,1,1-Trichloroethane	2/7	0.931	81.2	41.065	56.758
Trichloroethylene	5/7	0.013	142	53.258	71.407
Vinyl chloride	4/7	0.245	7.29	3.968	3.596
Methyl ethyl ketone	2/7	4.77	1150	577.385	809.799
m-Xylene	3/7	1.84	16.8	11.546	8.415
o + p - Xylenes	4/7	0.304	13.5	7.063	7.002
<u>Acid Compounds</u>					
2-Chlorophenol	1/7	0.014	0.017	0.016	0.0025
2,4-Dichlorophenol	2/7	0.463	1.09	0.776	0.443
2,4-Dimethyl phenol	5/7	0.004	0.191	0.1	0.0862
2-Nitrophenol	1/7	0.004	0.004	0.004	--
Phenol	7/7	0.0152	12.5	3.364	4.738
<u>Base/Neutral Compounds</u>					
Acenaphthene	2/7	0.003	0.040	0.022	0.025
Acenaphthylene	1/7	0.073	0.073	0.073	--
Anthracene	1/7	0.126	0.126	0.126	--
Benzo(a)pyrene	1/7	0.090	0.090	0.09	--
Benzo(b)fluoranthene	1/7	0.141	0.141	0.141	--

TABLE 19 (Continued)

<u>CHEMICAL</u>	<u>NO. OF OCCURRENCES</u>	<u>MINIMUM</u>	<u>MAXIMUM</u>	<u>MEAN</u>	<u>STANDARD DEVIATION</u>
<u>Base/Neutral Compounds</u>					
bis(2-Chloroethyl)ether	1/7	1.39	1.39	1.39	--
bis(2-Ethyl hexyl)phthalate	3/7	0.081	0.408	0.221	0.168
Chrysene	1/7	0.087	0.087	0.087	--
1,2-Dichlorobenzene	6/7	0.005	0.184	0.085	0.073
Diethyl phthalate	1/7	0.416	0.416	0.416	--
Di-n-butyl phthalate	1/7	0.318	0.318	0.318	--
Fluoranthene	1/7	0.266	0.266	0.266	--
Fluorene	1/7	0.133	0.133	0.133	--
Indeno(1,2,3-c,d)pyrene	1/7	0.060	0.060	0.060	--
Isophorone	3/7	0.022	4	1.379	2.27
Naphthalene	6/7	0.005	1.22	0.221	0.489
Nitrobenzene	2/7	24.9	57.9	41.4	23.334
Phenanthrene	1/7	0.62	0.62	0.62	--
Pyrene	1/7	0.228	0.228	0.228	--
<u>Pesticide Compounds</u>					
Beta - BHC	1/7	0.0006	0.0006	0.0006	--
4,4'-DDT	1/7	0.0017	0.0017	0.0017	--
Endosulfan I	1/7	0.0003	0.0003	0.0003	--
Endrin	1/7	0.0007	0.0007	0.0007	--

TABLE 19 (Continued)

<u>CHEMICAL</u>	<u>NO. OF OCCURRENCES</u>	<u>MINIMUM</u>	<u>MAXIMUM</u>	<u>MEAN</u>	<u>STANDARD DEVIATION</u>
<u>PCB Aroclors</u>					
Aroclor 1242	1/7	17	17	17	--
<u>Conventional Analysis Data</u>					
Phenolics, Total	7/7	0.099	31	7.67	11.18
Cyanide, Total	5/7	0.027	4.52	0.984	1.98
Petroleum Hydrocarbons	6/7	3.6	45.4	18.6	18.922
<u>Metals</u>					
Arsenic	3/7	0.045	1.6	0.588	0.876
Beryllium	3/7	0.0005	0.0013	0.0008	0.0003
Chromium	1/7	0.42	0.42	0.42	--
Copper	5/7	0.016	0.05	0.028	0.013
Nickel	4/7	0.043	0.092	0.0625	0.017
Zinc	6/7	0.021	0.14	0.051	0.044

TABLE 20

PHYSICOCHEMICAL PARAMETERS
TILL AQUIFER
SCP SITE

<u>Well No.</u>	<u>Temperature (°C)</u>		<u>pH (Standard Units)</u>		<u>Conductivity (umhos/cm)</u>	
	<u>July 1987</u>	<u>December 1987</u>	<u>July 1987</u>	<u>December 1987</u>	<u>July 1987</u>	<u>December 1987</u>
MW-20	18.1	12	10.85	11.33	2890	2901
MW-50	16.8	12	7.88	8.41	13850	1423
MW-70	19.1	11	8.49	6.67	877	737

TABLE 21

TILL AQUIFER SAMPLES
CHEMICALS DETECTED AT THE SCP SITE
BASED ON SAMPLES COLLECTED BY DAMES & MOORE, JULY 1987
(Values are in mg/l)

<u>CHEMICAL</u>	<u>WELL MW-2D</u>	<u>WELL MW-5D</u>	<u>WELL MW-7D</u>
<u>Volatile Compounds</u>			
Chlorobenzene	0.00635	---	---
Chloroform	28.6	0.124	0.0139
1,1-Dichloroethane	0.027	---	---
1,2-Dichloroethane	9.23	0.114	0.00896
1,1-Dichloroethylene	0.0975	0.313	---
Methylene chloride	0.206	0.139	0.033
Tetrachloroethylene	0.0177	0.996	0.0202
Toluene	0.0101	---	---
1,2-Trans-dichloroethylene	0.0147	0.190	---
1,1,1-Trichloroethane	0.218	0.417	0.0127
Trichloroethylene	6.26	4.52	0.0738
Vinyl chloride	0.0543	---	---
<u>Base/Neutral Compounds</u>			
1,2-Dichlorobenzene	---	0.00527	---
Nitrobenzene	---	0.0209	0.00331
<u>Metals</u>			
Dissolved zinc	---	---	0.030
Total copper	0.019	---	---
Total zinc	0.045	---	0.039

TABLE 22

TILL AQUIFER SAMPLES
 CHEMICALS DETECTED AT THE SCP SITE
 BASED ON SAMPLES COLLECTED BY DAMES & MOORE, DECEMBER 1987
 (Values are in mg/l)

CHEMICAL	WELL MW-2D	WELL MW-5D	WELL MW-7D
<u>Volatile Compounds</u>			
Chlorobenzene	0.630	---	---
Chloroform	8.38	1.670	---
1,1-Dichloroethane	---	---	---
1,2-Dichloroethane	11.2	2.33	---
1,1-Dichloroethylene	1.22	---	---
Methylene chloride	2.140	0.137	0.00691
Tetrachloroethylene	10.6	---	---
Toluene	---	---	0.00601
1,2-Trans-dichloroethylene	1.22	---	---
1,1,1-Trichloroethane	3.45	---	---
Trichloroethylene	34.5	1.62	0.0131
Vinyl Chloride	---	---	---
<u>Acid Compounds</u>			
Phenol	0.00216	---	---
<u>Base/Neutral Compounds</u>			
1,2-Dichlorobenzene	---	0.00746	---
Nitrobenzene	---	0.0233	---
<u>PCB Aroclors</u>			
Aroclor 1232	---	0.0018	---
<u>Metals</u>			
Dissolved zinc	---	0.021	0.020
Total copper	---	---	---
Total zinc	0.036	0.022	0.057
<u>Petroleum Hydrocarbons</u>			
	---	---	1.3

TABLE 23

SURFACE WATER SAMPLES
OCCURRENCE OF CHEMICALS DETECTED AT THE SCP SITE
BASED ON SAMPLES COLLECTED BY DAMES & MOORE, JULY 1987
(Values are in mg/l)

<u>CHEMICAL</u>	<u>NO. OF OCCURRENCES</u>	<u>MINIMUM</u>	<u>MAXIMUM</u>	<u>MEAN</u>	<u>STANDARD DEVIATION</u>
<u>Volatile Compounds</u>					
Chloroform	1/4	0.00184	0.00184	0.00184	--
1,2-Dichloroethane	1/4	0.00527	0.00527	0.00527	--
Methylene Chloride	3/4	0.0106	0.017	0.0132	0.0033
1,2-Trans-dichloroethylene	4/4	0.0037	0.00956	0.00712	0.00252
1,1,1-Trichloroethane	2/4	0.0054	0.0129	0.00916	0.00528
<u>Conventional Analysis Data</u>					
Phenolics, Total	1/4	0.061	0.061	0.061	--
Petroleum Hydrocarbons	4/4	6.63	7.18	6.9375	0.227
<u>Dissolved Metals</u>					
Nickel	4/4	0.010	0.011	0.01075	0.001
Zinc	4/4	0.039	0.150	0.0865	0.05
<u>Total Metals</u>					
Copper	2/4	0.026	0.040	0.033	0.01
Mercury	1/4	0.00023	0.00023	0.00023	--
Nickel	4/4	0.0093	0.031	0.017	0.01
Zinc	4/4	0.049	0.160	0.103	0.06

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TABLE 24

SURFACE WATER SAMPLES
OCCURRENCE OF CHEMICALS DETECTED AT THE SCP SITE
BASED ON SAMPLES COLLECTED BY DAMES & MOORE, DECEMBER 1987
(Values are in mg/l)

<u>CHEMICAL</u>	<u>NO. OF OCCURRENCES</u>	<u>MINIMUM</u>	<u>MAXIMUM</u>	<u>MEAN</u>	<u>STANDARD DEVIATION</u>
<u>Volatile Compounds</u>					
Chlorobenzene	2/4	0.008	0.012	0.0102	0.0027
Chloroform	2/4	0.00356	0.00358	0.000357	0.00014
1,2-Dichloroethane	2/4	0.013	0.015	0.0145	0.00113
Methylene Chloride	4/4	0.004	0.014	0.0096	0.00502
Toluene	2/4	0.020	0.048	0.034	0.0194
1,2-Trans-dichloroethylene	3/4	0.003	0.035	0.024	0.0175
1,1,1-Trichloroethane	2/4	0.0055	0.0063	0.0059	0.00055
Trichloroethylene	1/4	0.0038	0.0038	0.0038	--
Methyl ethyl ketone	3/4	0.045	0.075	0.056	0.0161
m-Xylene	1/4	0.0107	0.0107	0.0107	--
o + p-Xylenes	1/4	0.010	0.010	0.010	--
<u>Conventional Analysis Data</u>					
Phenolics, Total	2/4	0.063	0.133	0.098	0.049
<u>Dissolved Metals</u>					
Copper	3/4	0.013	0.016	0.014	0.002
Mercury	1/4	0.00063	0.00063	0.00063	--
Nickel	3/4	0.031	0.049	0.0383	0.01
Zinc	3/4	0.082	0.130	0.1007	0.03
<u>Total Metals</u>					
Chromium	2/4	0.028	0.056	0.0435	0.02
Copper	4/4	0.012	0.100	0.042	0.04
Mercury	4/4	0.00096	0.0048	0.00224	0.002
Nickel	3/4	0.027	0.057	0.039	0.02
Zinc	4/4	0.087	0.370	0.1918	0.12

TABLE 25

SURFACE WATER SAMPLES - PEACH ISLAND CREEK
 BASED ON SAMPLES COLLECTED BY DAMES & MOORE, JULY AND DECEMBER 1987
 (Values are in ug/l)

CHEMICAL	DOWNSTREAM				SITE		UPSTREAM	
	SW-1(J)	SW-1(D)	SW-2(J)	SW-2(D)	SW-3(J)	SW-3(D)	SW-4(J)	SW-4(D)
<u>Volatile Organic Compounds</u>								
Chlorobenzene	ND	ND	ND	12.2	ND	8.34	ND	ND
Chloroform	BMDL	ND	BMDL	3.56	1.84	3.58	ND	ND
1,2-Dichloroethane	ND	ND	5.27	15.3	ND	13.7	ND	ND
Methylene chloride	17.0	14.9	ND	12.9	12.1	6.12	10.6	4.63
Toluene	ND	ND	ND	48.1	ND	20.6	ND	BMDL
1,2-Transdichloroethylene	3.78	3.91	6.69	33.3	9.56	35.2	8.46	ND
1,1,1-Trichloroethane	ND	ND	BMDL	5.54	12.9	6.32	5.42	ND
Trichloroethylene	ND	ND	ND	ND	BMDL	3.83	ND	ND
Methyl ethyl ketone	ND	ND	ND	49.2	ND	45.4	ND	75.0
m-Xylene	ND	ND	ND	10.7	ND	BMDL	ND	ND
o + p-Xylenes	ND	BMDL	ND	10.0	ND	BMDL	ND	ND
Total Phenolics	61	BMDL	BMDL	133	BMDL	63	BMDL	BMDL
<u>Dissolved Metals</u>								
Copper	BMDL	ND	BMDL	16	BMDL	13	BMDL	13
Mercury	BMDL	0.63	BMDL	BMDL	BMDL	BMDL	BMDL	BMDL
Nickel	10	ND	11	31	11	35	11	49
Zinc	39	ND	63	90	150	82	94	130
<u>Total Metals</u>								
Chromium	BMDL	BMDL	BMDL	28	BMDL	BMDL	BMDL	56
Copper	BMDL	12	BMDL	27	26	29	40	100
Mercury	0.23	2.1	BMDL	1.1	BMDL	0.96	BMDL	4.8
Nickel	31	BMDL	10	27	9.3	33	18	57
Zinc	53	87	49	150	150	160	160	370

ND = Not Detected

BMDL = Parameter detected but at concentration below the method detection limit

(J),(D) = Samples collected in July (J) or December (D), 1987

TABLE 26

SEDIMENT SAMPLES
 OCCURRENCE OF CHEMICALS DETECTED AT THE SCP SITE
 BASED ON SAMPLES COLLECTED BY DAMES & MOORE, DECEMBER 1987
 (Values are in mg/kg)

<u>CHEMICAL</u>	<u>NO. OF OCCURRENCES</u>	<u>MINIMUM</u>	<u>MAXIMUM</u>	<u>MEAN</u>	<u>STANDARD DEVIATION</u>
<u>Volatile Compounds</u>					
Benzene	3/8	0.033	1.99	0.701	1.115
Chlorobenzene	6/8	0.047	17.1	5.976	6.486
Chloroform	2/8	3.69	3.79	3.74	0.07
1,2-Dichloroethane	1/8	1.96	1.96	1.96	--
Ethyl benzene	7/8	0.029	439	95.8	163.34
Methylene chloride	2/8	0.043	3.69	1.866	2.579
1,1,2,2-Tetrachloroethane	1/8	0.046	0.046	0.046	--
Tetrachloroethylene	2/8	304	953	628.5	458.91
Toluene	6/8	4.51	2970	852.08	1221.93
1,2-Trans-dichloroethylene	1/8	1.61	1.61	1.61	--
1,1,1-Trichloroethane	2/8	75.5	222	148.75	103.59
Trichloroethylene	3/8	1.89	9950	4403.96	5071.75
Methyl ethyl ketone	3/8	0.065	31.9	16.75	15.97
m-Xylene	8/8	0.093	1060	207.26	382.07
o + p-Xylenes	8/8	0.141	647	139.62	236.05
<u>Acid Compounds</u>					
2,4-Dimethylphenol	1/8	1.36	1.36	1.36	--
Phenol	4/8	6.56	44.7	21.59	17.32
<u>Base/Neutral Compounds</u>					
Acenaphthene	2/8	0.166	0.358	0.262	0.135
Anthracene	1/8	0.321	0.321	0.321	--
Benzo(a)anthracene	1/8	0.878	0.878	0.878	--
Benzo(a)pyrene	2/8	0.148	0.757	0.452	0.43
Benzo(b)fluoranthene	1/8	1.53	1.53	1.53	--
Benzo(ghi)perylene	1/8	0.636	0.636	0.636	--

100150

TABLE 26 (continued)

<u>CHEMICAL</u>	<u>NO. OF OCCURRENCES</u>	<u>MINIMUM</u>	<u>MAXIMUM</u>	<u>MEAN</u>	<u>STANDARD DEVIATION</u>
<u>Base/Neutral Compounds</u>					
bis(2-Ethyl hexyl)phthalate	8/8	2.92	356	101.22	129.4
Butyl benzyl phthalate	2/8	0.736	9.7	5.218	6.338
2-Chloronaphthalene	2/8	0.115	0.226	0.17	0.078
Chrysene	2/8	0.332	1.01	0.671	0.479
1,2-Dichlorobenzene	6/8	0.424	261	44.706	105.968
1,4-Dichlorobenzene	1/8	7.84	7.84	7.84	--
Di-n-butyl phthalate	4/8	0.884	24.8	9.758	10.976
Di-n-octyl phthalate	3/8	0.6	12.2	4.579	6.601
Fluoranthene	5/8	0.374	2.26	0.895	0.795
Fluorene	3/8	0.202	0.536	0.408	0.18
Indeno (1,2,3-c,d)pyrene	1/8	0.683	0.683	0.683	--
Naphthalene	6/8	0.379	20.3	4.259	7.868
Phenanthrene	4/8	0.556	2.75	1.459	1.028
Pyrene	4/8	0.339	1.85	0.862	0.712
1,2,4-Trichlorobenzene	3/8	0177	2.33	1.01	1.155
<u>Pesticide Compounds</u>					
Dieldrin	1/8	11	11	11	--

100151

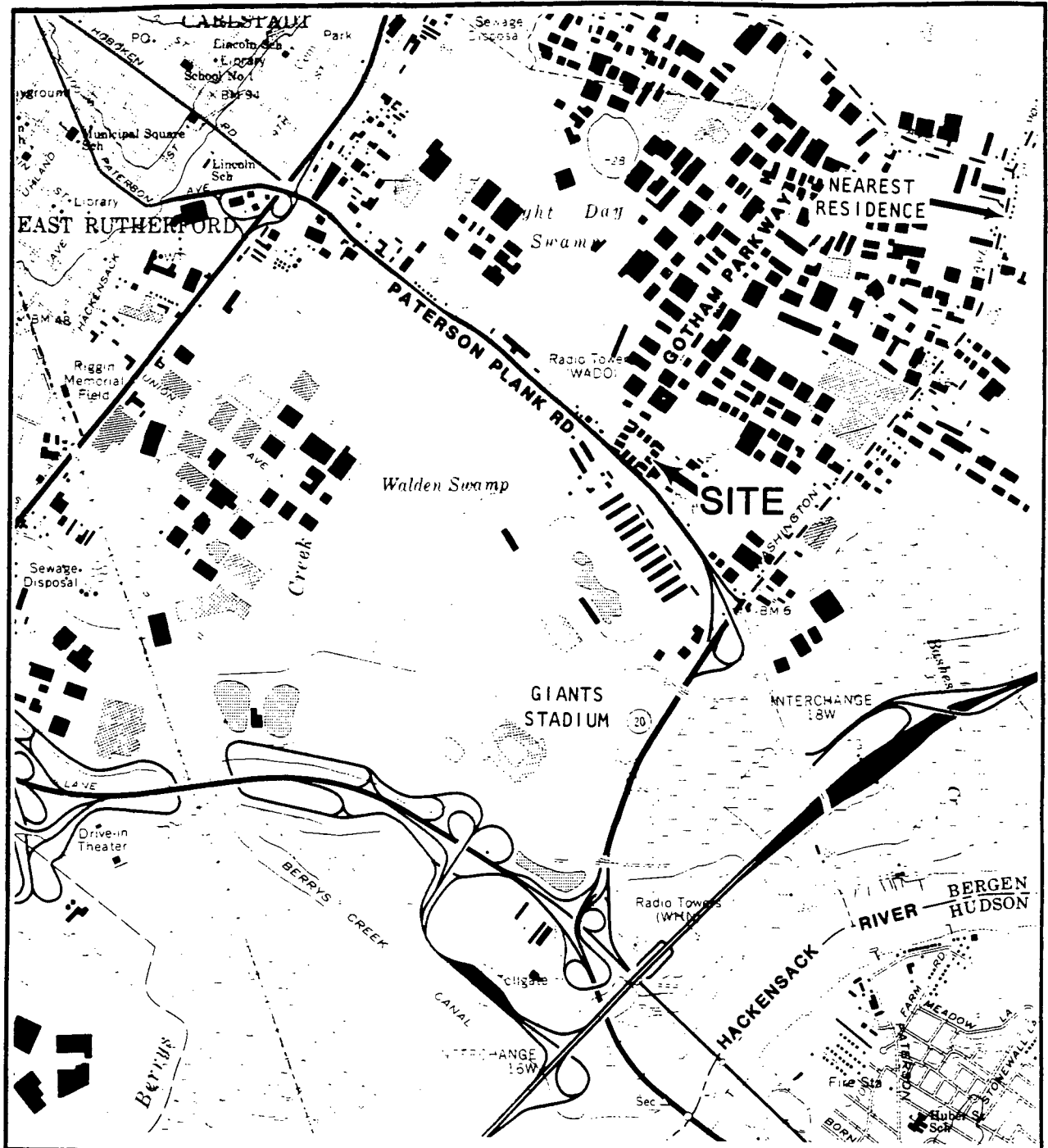
TABLE 26 (continued)

<u>CHEMICAL</u>	<u>NO. OF OCCURRENCES</u>	<u>MINIMUM</u>	<u>MAXIMUM</u>	<u>MEAN</u>	<u>STANDARD DEVIATION</u>
<u>PCB Aroclors</u>					
Aroclor 1242	6/8	8.8	770	162.8	298.735
Aroclor 1254	1/8	5.2	5.2	5.2	--
Aroclor 1260	4/8	2.8	22	10.2	8.4
Aroclor 1248	2/8	19	42	30.5	16.263
<u>Conventional Analysis Data</u>					
Phenolics, Total	8/8	12	315	79.625	103.968
Cyanide, Total	8/8	1.2	205	50.312	73.805
Petroleum Hydrocarbons	8/8	4400	25900	11793.75	7397.08
<u>Metals</u>					
Arsenic	6/8	15	37	26	9.252
Beryllium	8/8	0.39	2.4	1.16	0.714
Cadmium	8/8	12	83.7	44.375	24.492
Chromium	8/8	156	1170	579.5	386.513
Copper	8/8	835	9510	2667	2840.498
Lead	8/8	96	520	335.75	129.665
Mercury	8/8	0.34	139	53.63	54.232
Nickel	8/8	96	467	245.625	163.979
Selenium	1/8	0.89	0.89	0.89	--
Silver	4/8	2.4	8.6	5.325	3.232
Zinc	8/8	411	3680	2197.625	1101.646

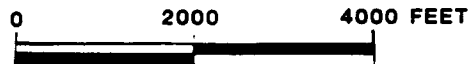
100152

F
I
G
U
R
E
S

R1/F3
40 49 30 W
74 04 30 W



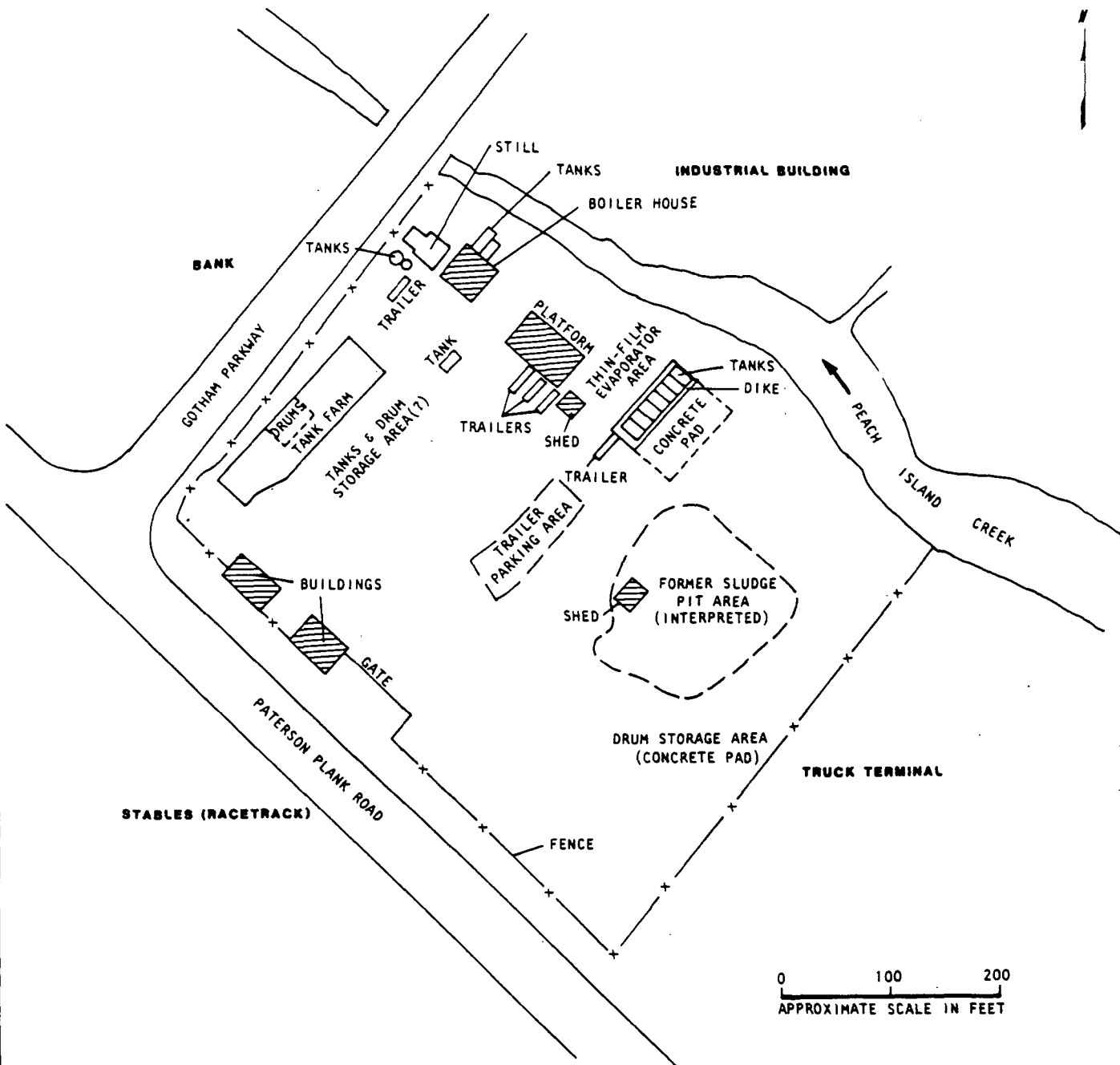
SITE LOCATION MAP **SCP SITE** **CARLSTADT, NEW JERSEY**



REFERENCE:
U.S.G.S. 7.5' QUADRANGLE:
WEEHAWKEN, N.J., N.Y., 1967,
PHOTO REVISED 1981

DAMES & MOORE

FIGURE 1



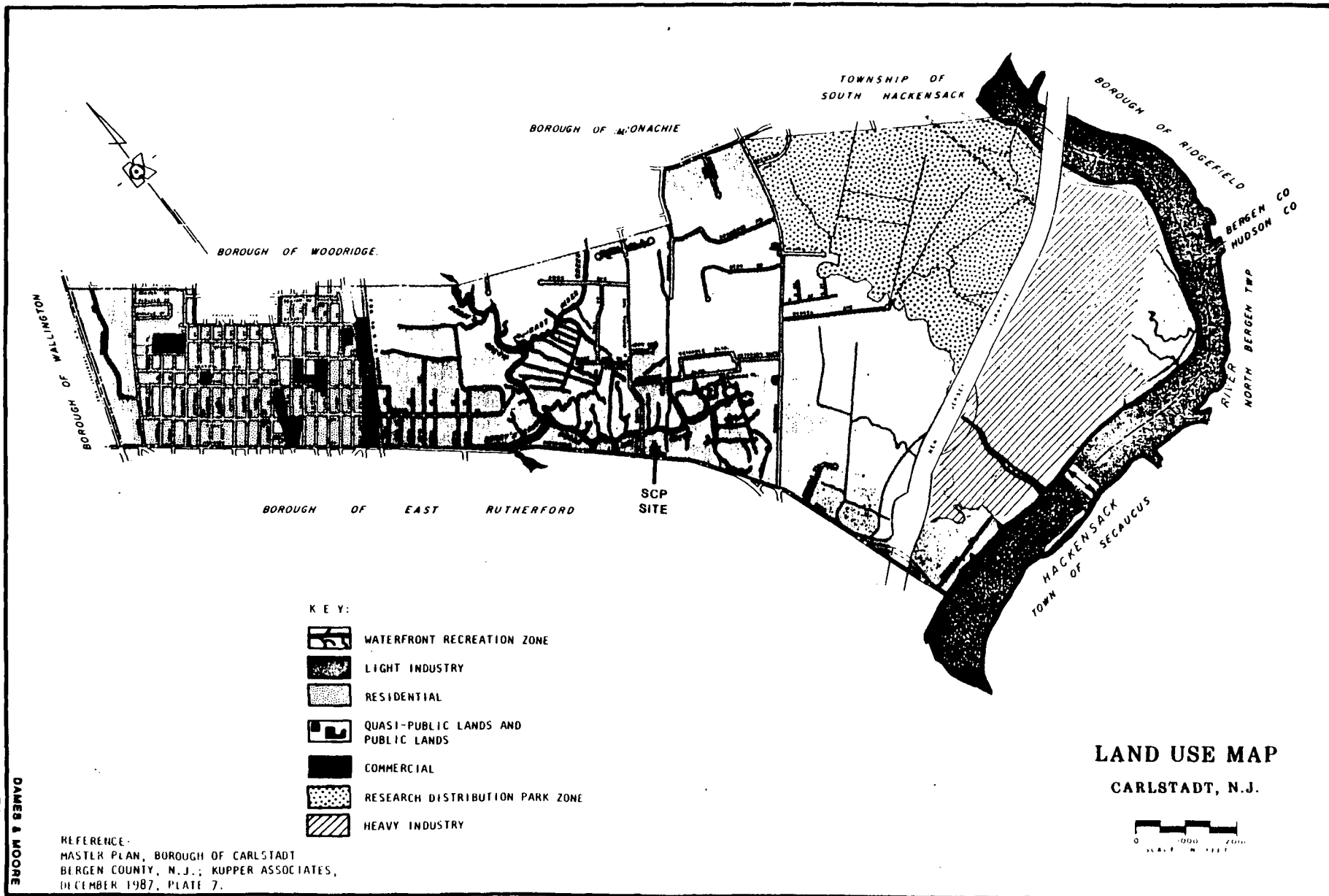
SITE LAYOUT SCP SITE CARLSTADT, NEW JERSEY

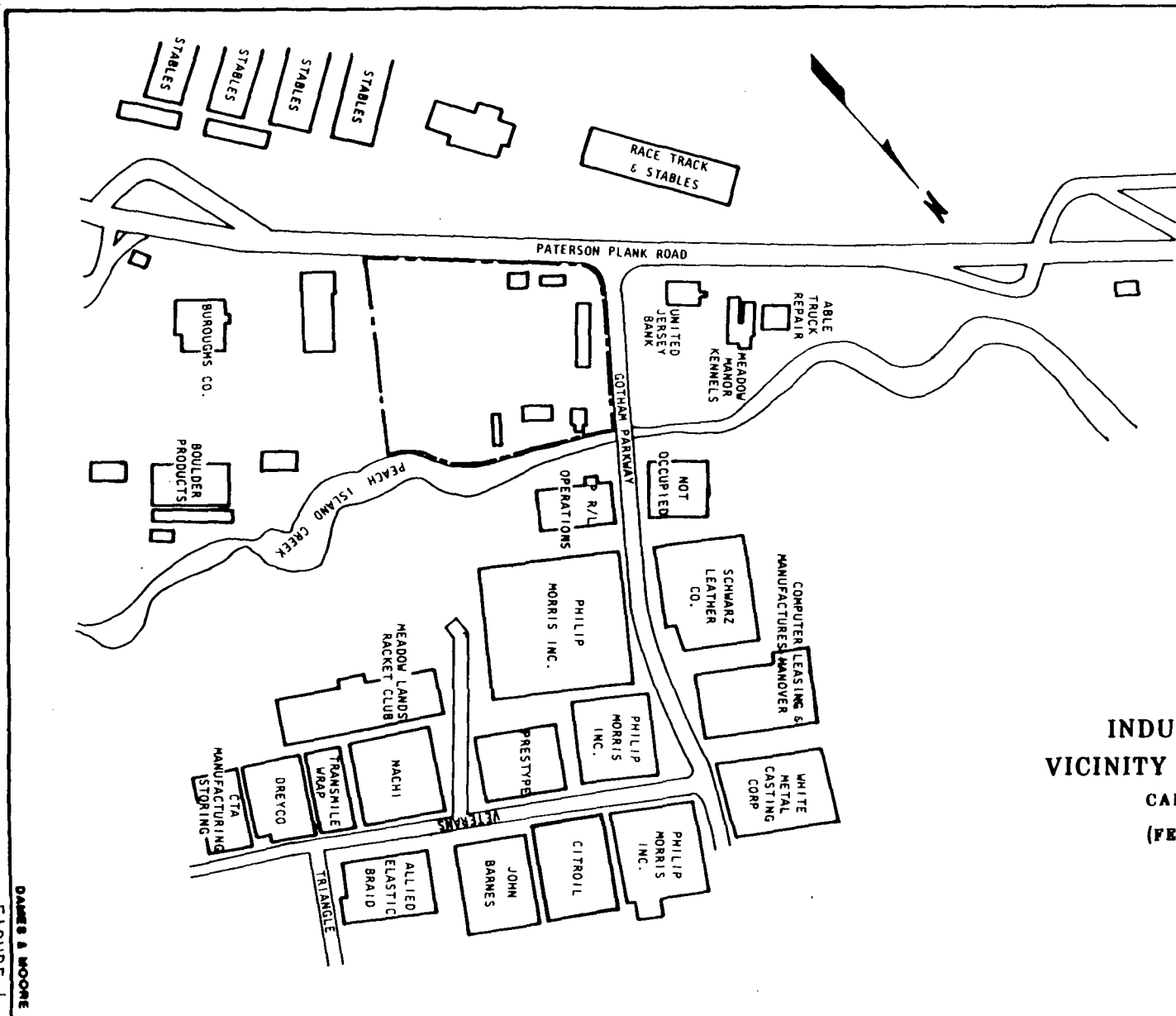
NOTES:

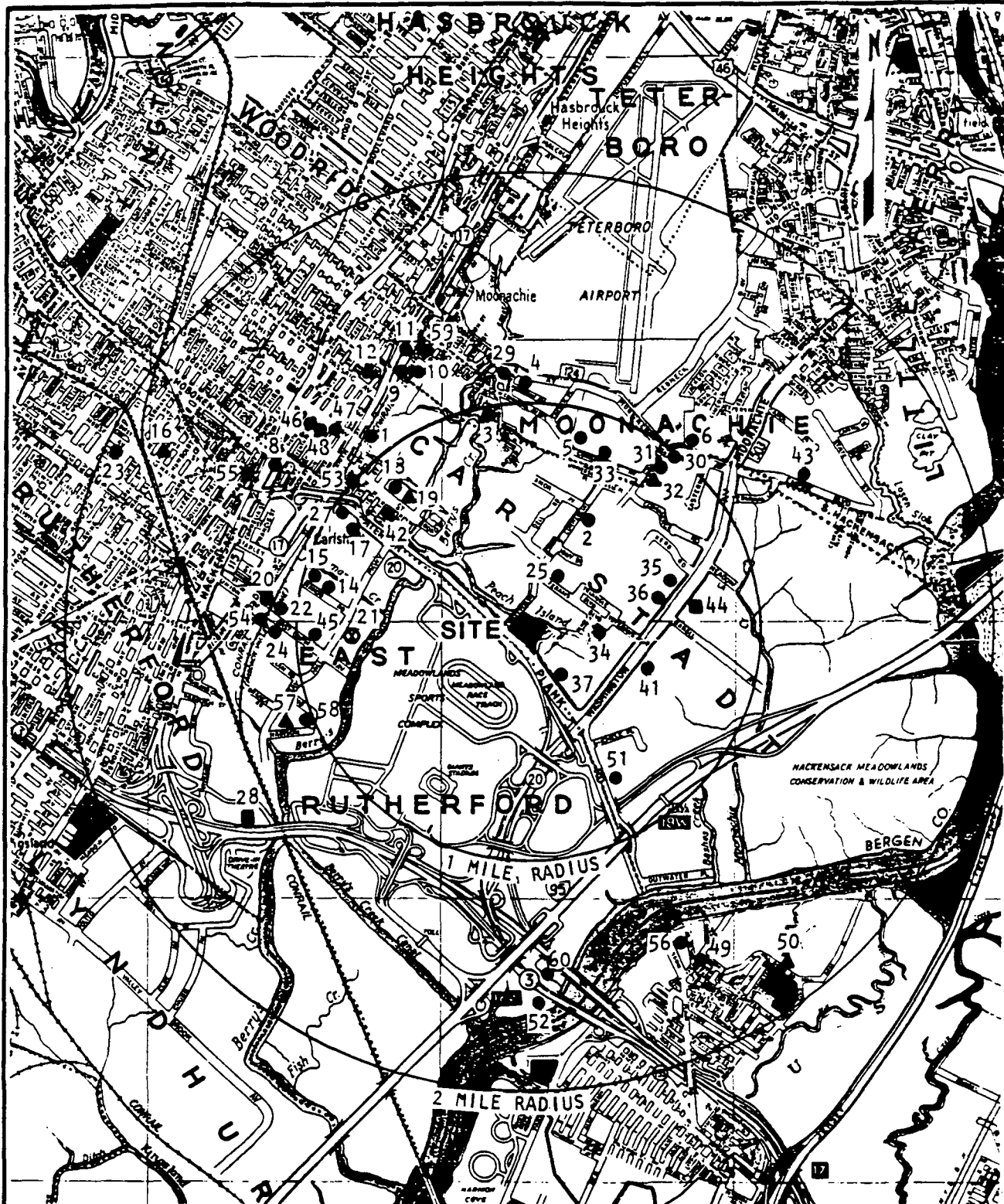
1. ALL DRUMS, MOST TANKS AND TANK TRAILERS HAVE BEEN REMOVED AND SOME FACILITIES HAVE BEEN DISMANTLED SINCE OPERATIONS CEASED IN 1979.
2. BASE MAP REFERENCE: AERIAL PHOTOGRAPH NO. 3818-6-35, MARCH 27, 1984. SCALE: 1" = 100'±

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FIGURE 2







APPROXIMATE WELL LOCATIONS IN THE VICINITY OF THE CARLSTADT SITE

0 2000 4000 6000 FEET

NOTE:

SEE TABLE 1 FOR WELL DESCRIPTIONS
BY INDEX NUMBER. 5 WELLS COULD NOT
BE PLOTTED.

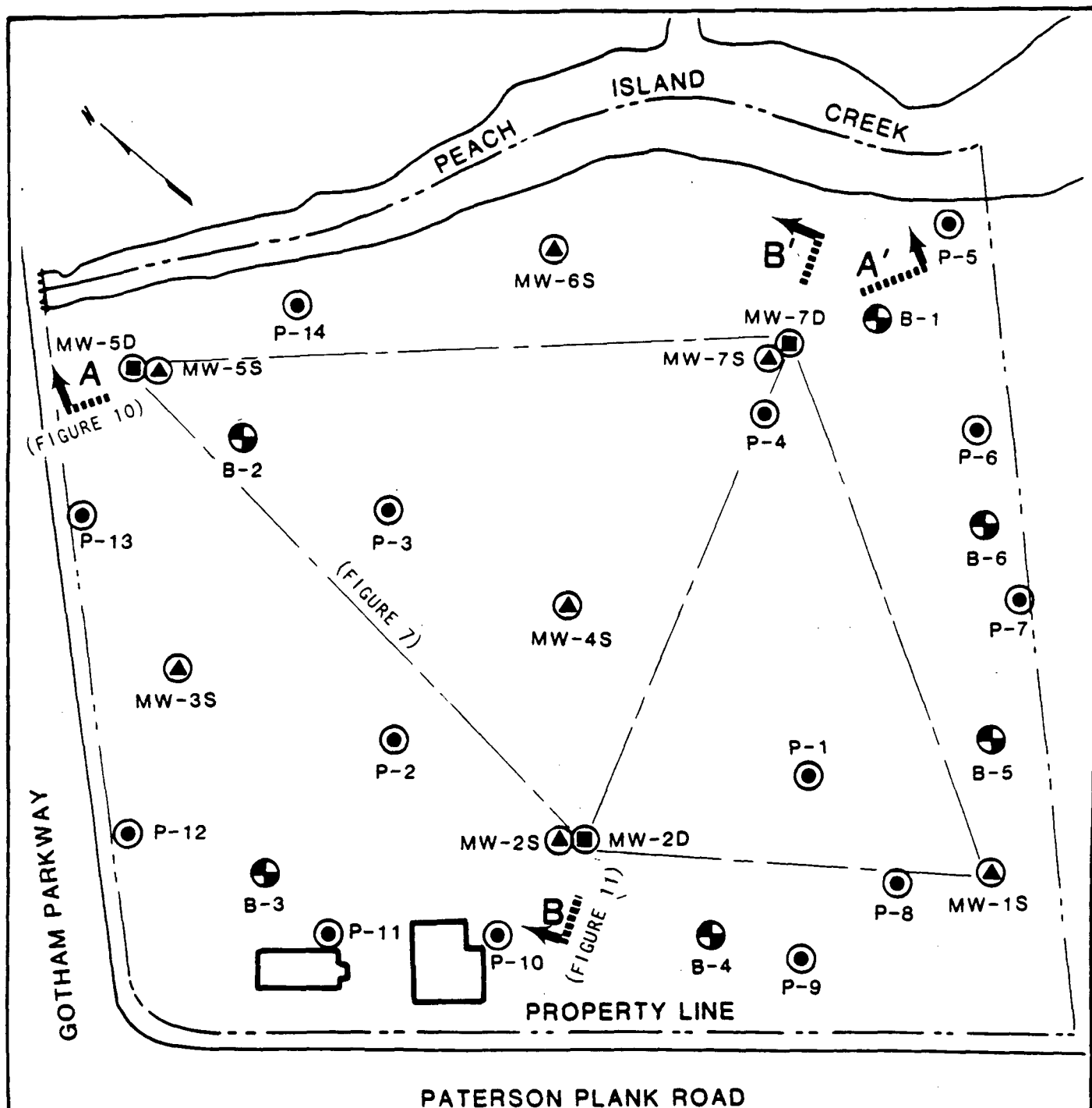
KEY:

- INDUSTRIAL WELLS
- ▲ DOMESTIC OR FOOD PROCESSING WELLS
- ⊙ IRRIGATION WELLS
- UNKNOWN PURPOSE WELLS

DAMES & MOORE

FIGURE 5

100158



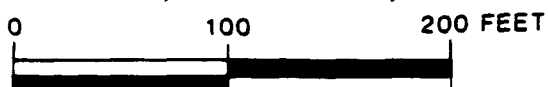
NOTE: REPLACEMENT BORINGS WITH PREFIX "R" WERE DRILLED ADJACENT TO ORIGINAL BORING LOCATIONS. FOR CLARITY THE "R" BORINGS ARE NOT SHOWN ON THIS FIGURE. SEE SECTION 4.2.1 FOR DISCUSSION.

LOCATION PLAN

BORINGS, PIEZOMETERS AND WELLS

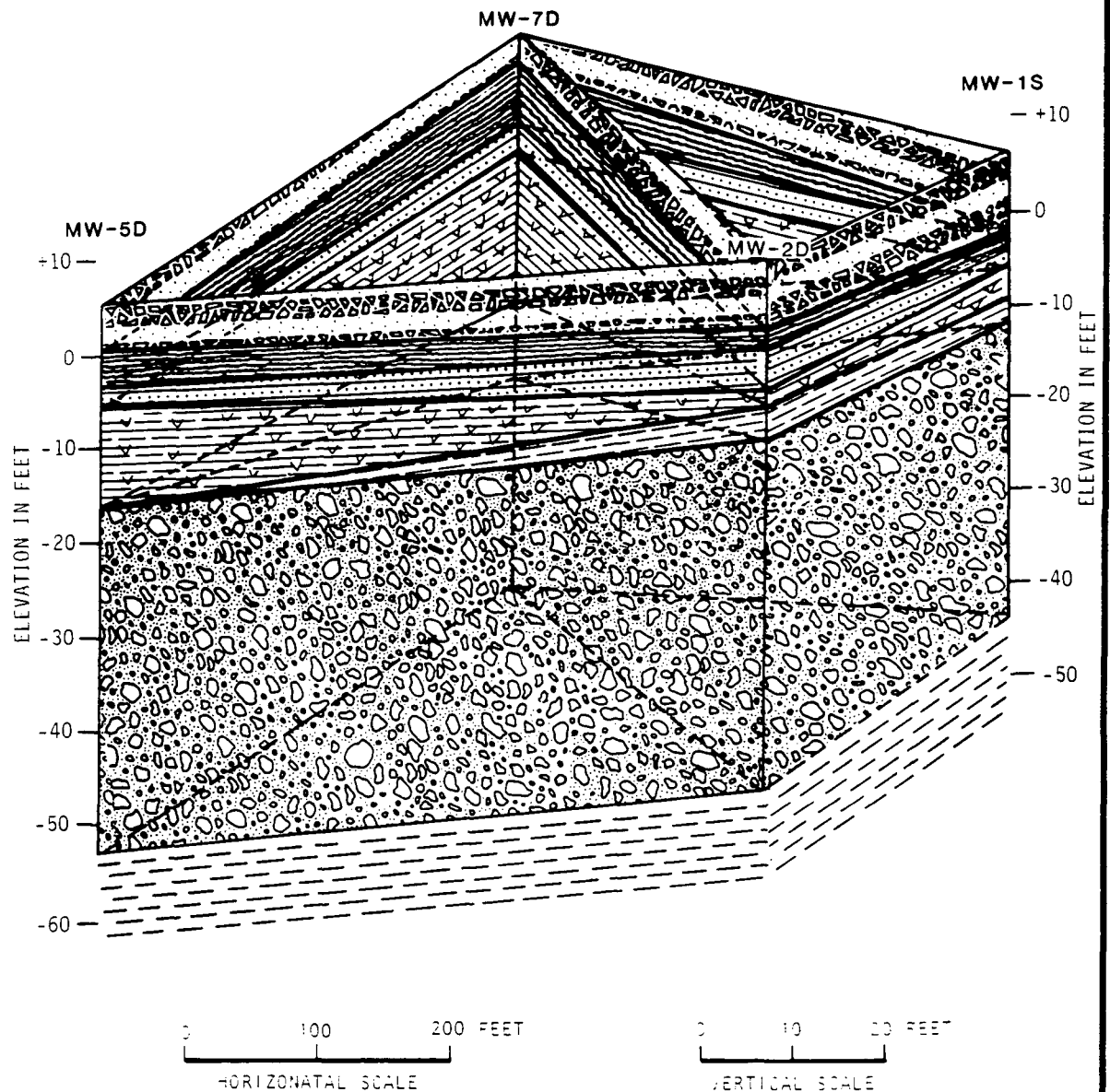
- KEY:
- SOIL BORING
 - SHALLOW PIEZOMETER
 - ▲ SHALLOW MONITORING WELL
 - DEEP MONITORING WELL

SCP SITE, CARLSTADT, N.J.



DAMES & MOORE

FIGURE 6



COMPOSITE GEOLOGIC SECTION

SCP SITE
CARLSTADT, NEW JERSEY

KEY:



FILL



GRAY SILT



RED CLAY



RED SHALE



PEAT



VARVED CLAY



TILL (UNDIFFERENTIATED)

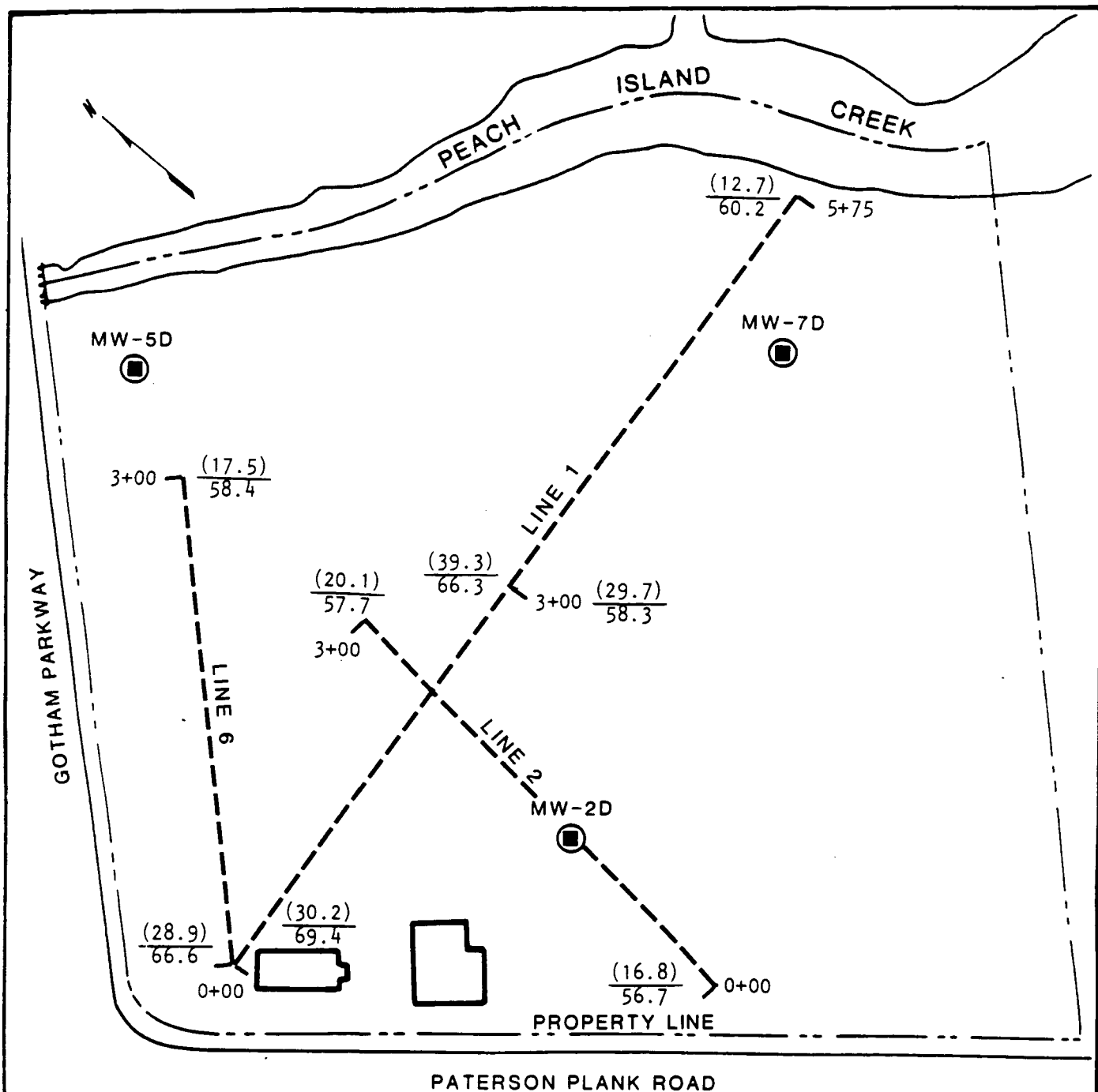
SEE FIGURE 6 FOR SECTION LOCATION

NOTE:
THE SUBSURFACE SECTION SHOWN REPRESENTS OUR
EVALUATION OF THE MOST PROBABLE CONDITIONS
BASED UPON INTERPRETATION OF PRESENTLY AVAIL-
ABLE DATA. SOME VARIATIONS FROM THESE CONDITIONS
MUST BE EXPECTED.

DAMES & MOORE

FIGURE 7

100160



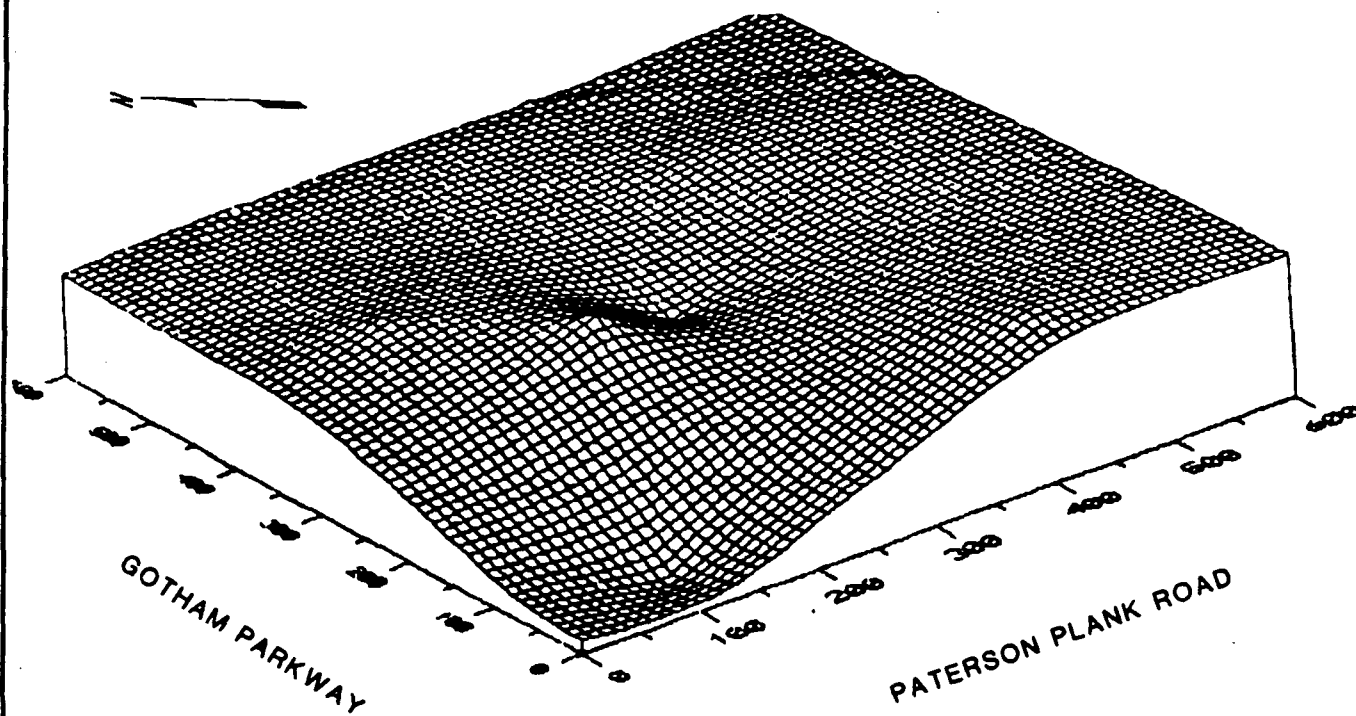
SEISMIC LINES **SCP SITE, CARLSTADT, N.J.**



KEY:
 (17.5) INTERPRETED DEPTH TO TILL (FT)
 58.4 INTERPRETED DEPTH TO ROCK (FT)

DAMES & MOORE

FIGURE 8



BEDROCK SURFACE

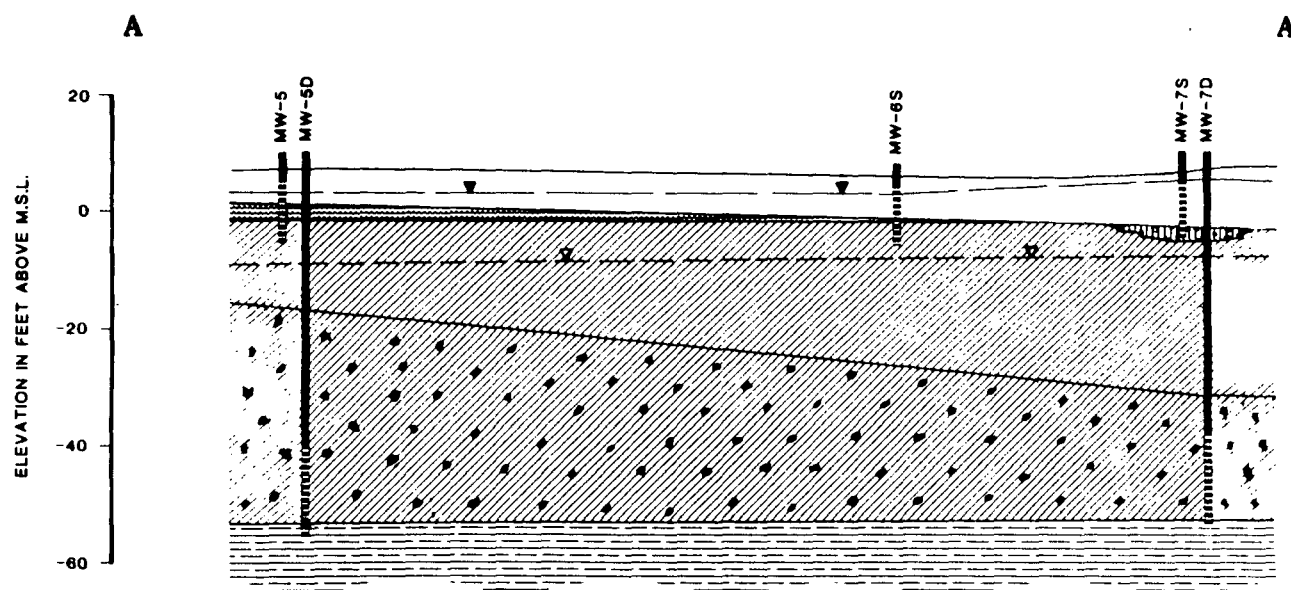
SCP SITE
CARLSTADT, N.J.

Dames & Moore

FIGURE 9

100162

NOTE:
THE SUBSURFACE SECTION SHOWN REPRESENTS OUR
EVALUATION OF THE MOST PROBABLE CONDITIONS
BASED UPON INTERPRETATION OF PRESENTLY AVAIL-
ABLE DATA. SOME VARIATIONS FROM THESE CONDITIONS
MUST BE EXPECTED.



KEY:

- MISCELLANEOUS FILL
- PEAT
- GRAY SILTY FINE SAND
- GRAY & BROWN CLAYEY SILT & CLAY (LACUSTRINE)
- REDDISH BROWN MIXTURE OF CLAY, SILT, SAND & GRAVEL (GLACIAL TILL)
- REDDISH BROWN BRUNSWICK SHALE
- SCREENED INTERVAL
- WATER TABLE SURFACE
- POTENTIOMETRIC SURFACE

NOTE: WATER LEVELS MEASURED
ON AUGUST 4, 1987

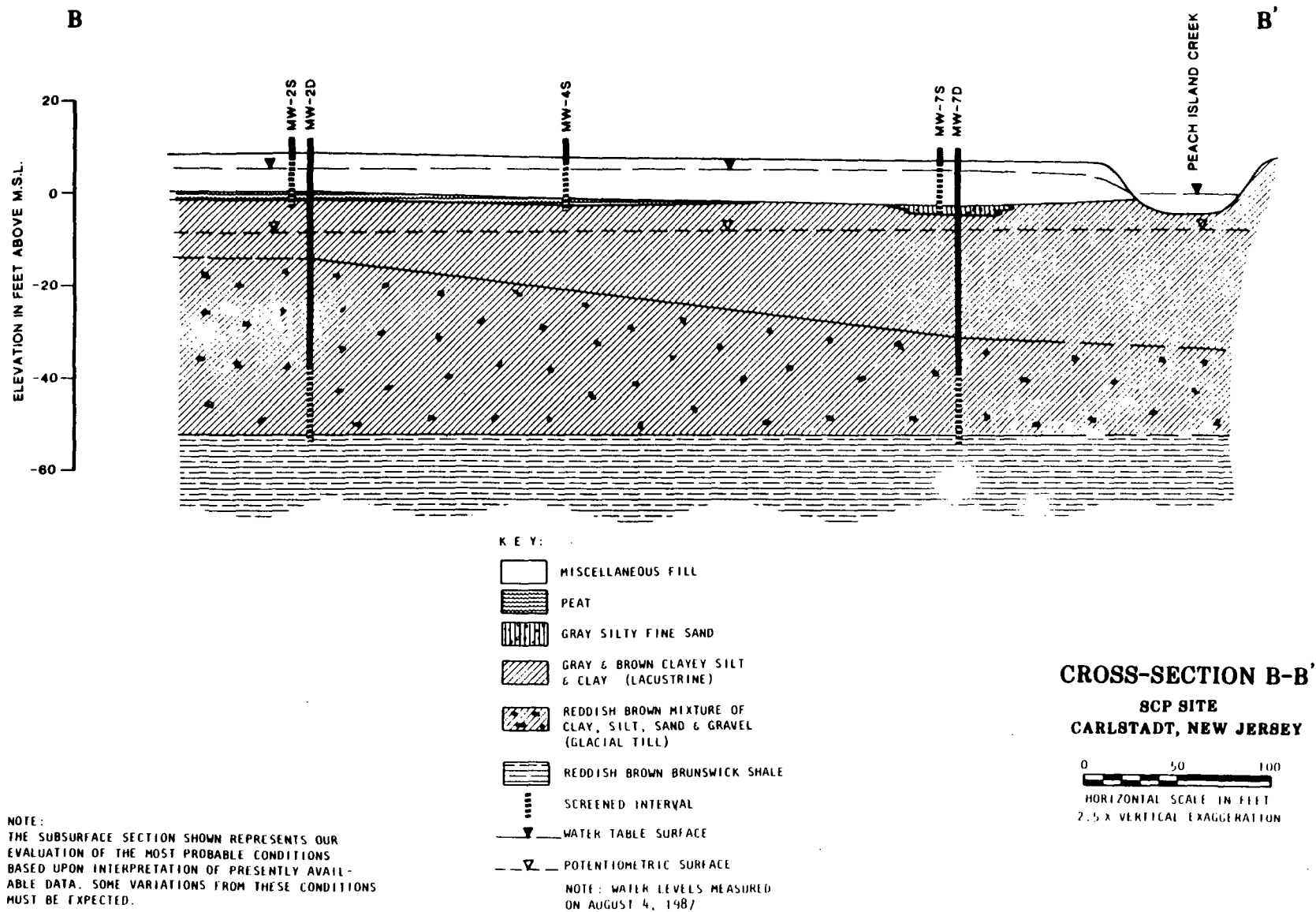
CROSS-SECTION A-A'

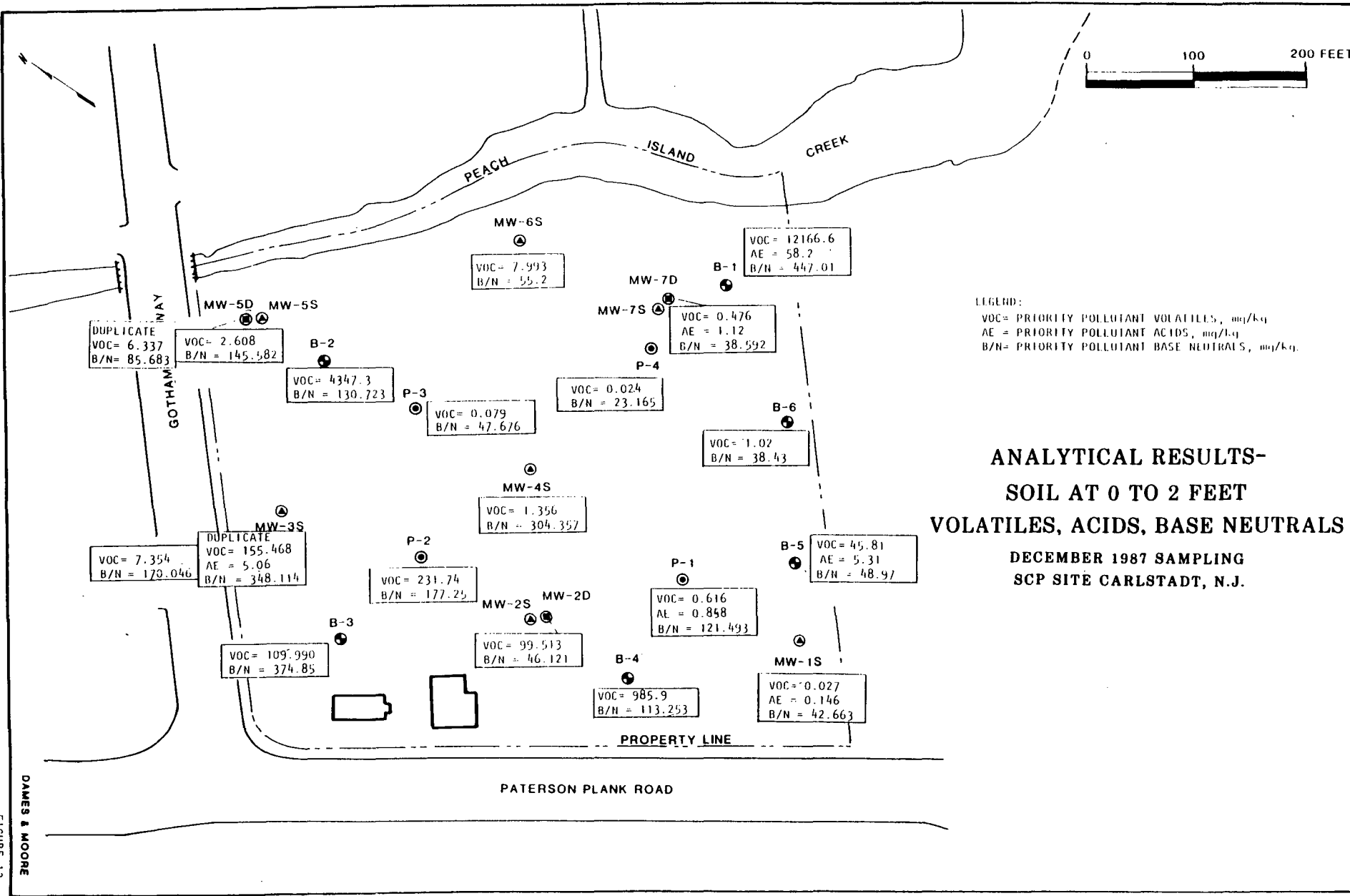
SCP SITE
CARLSTADT, NEW JERSEY

0 50 100
HORIZONTAL SCALE IN FEET
2.5 X VERTICAL EXAGGERATION

FIGURE 11

DAMES & MOORE

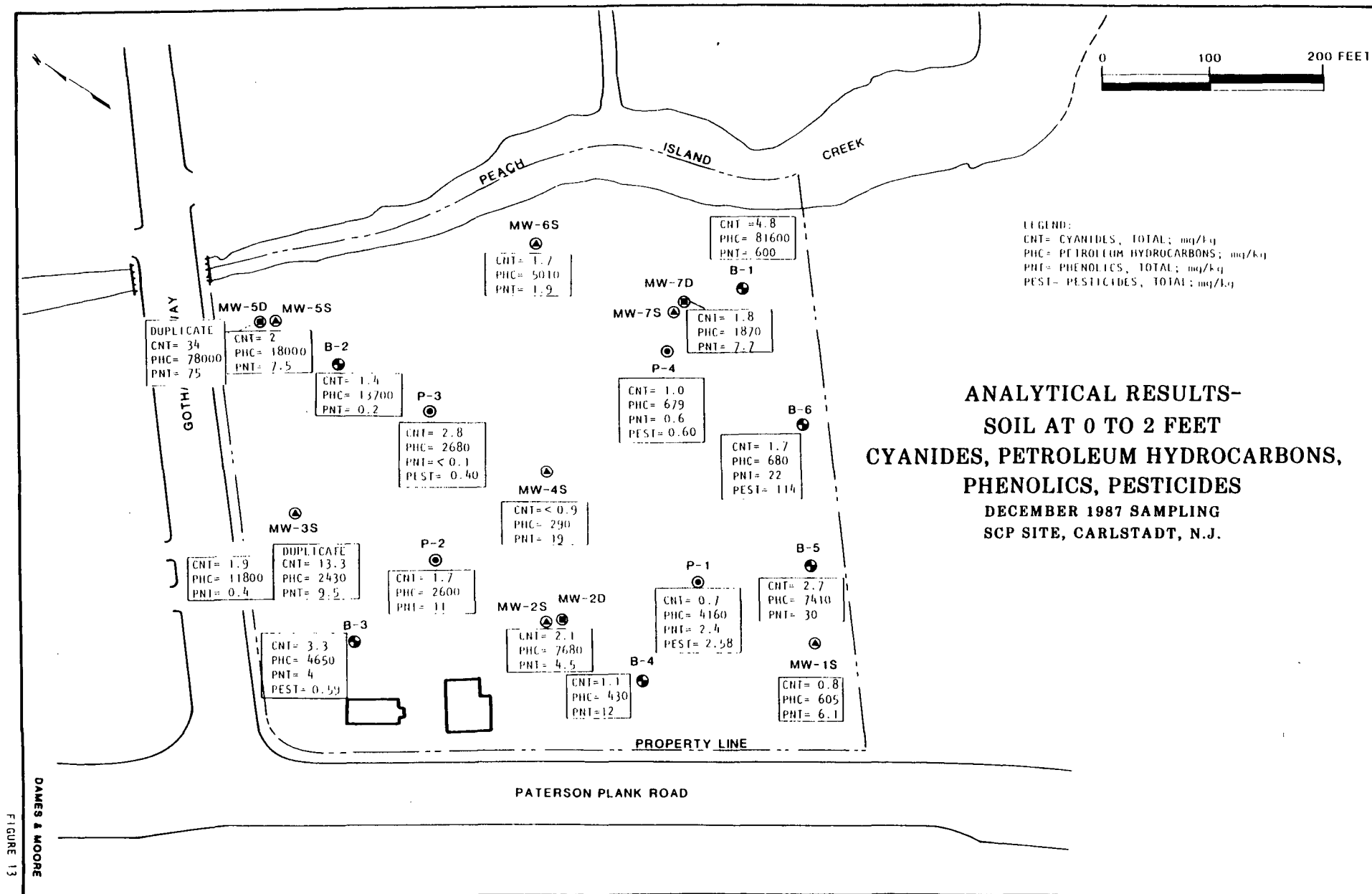




100165

FIGURE 12

DAMES & MOORE



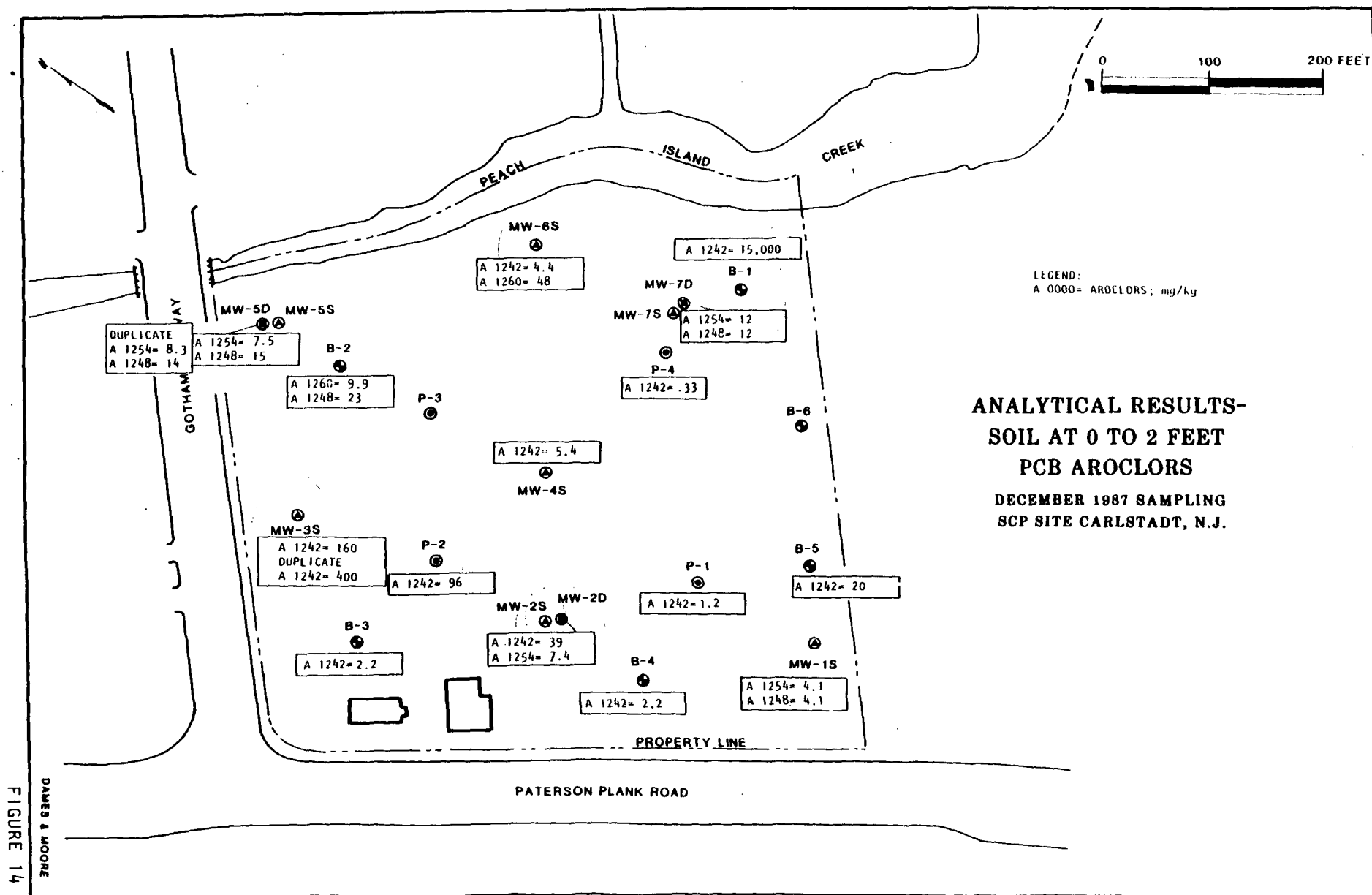
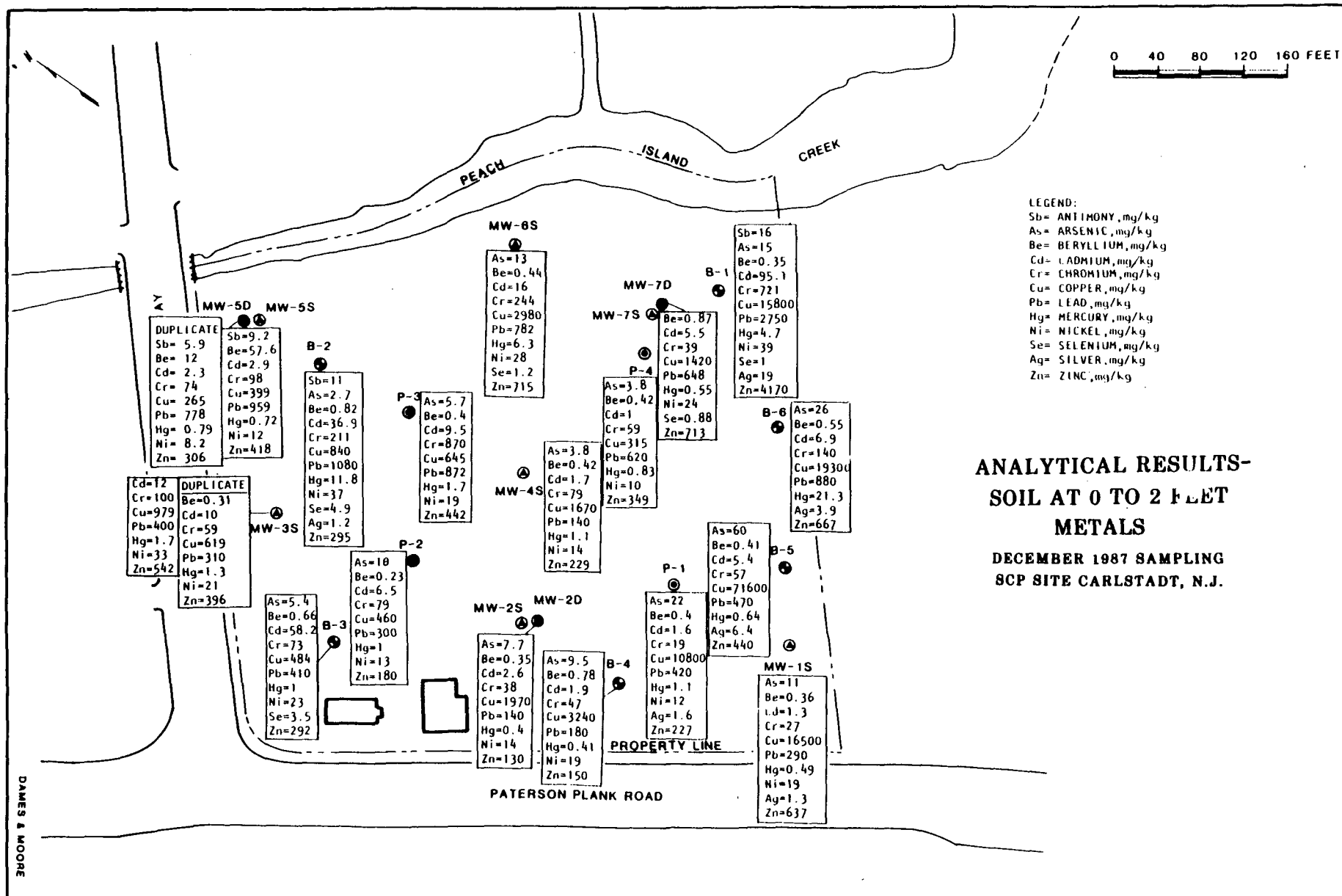


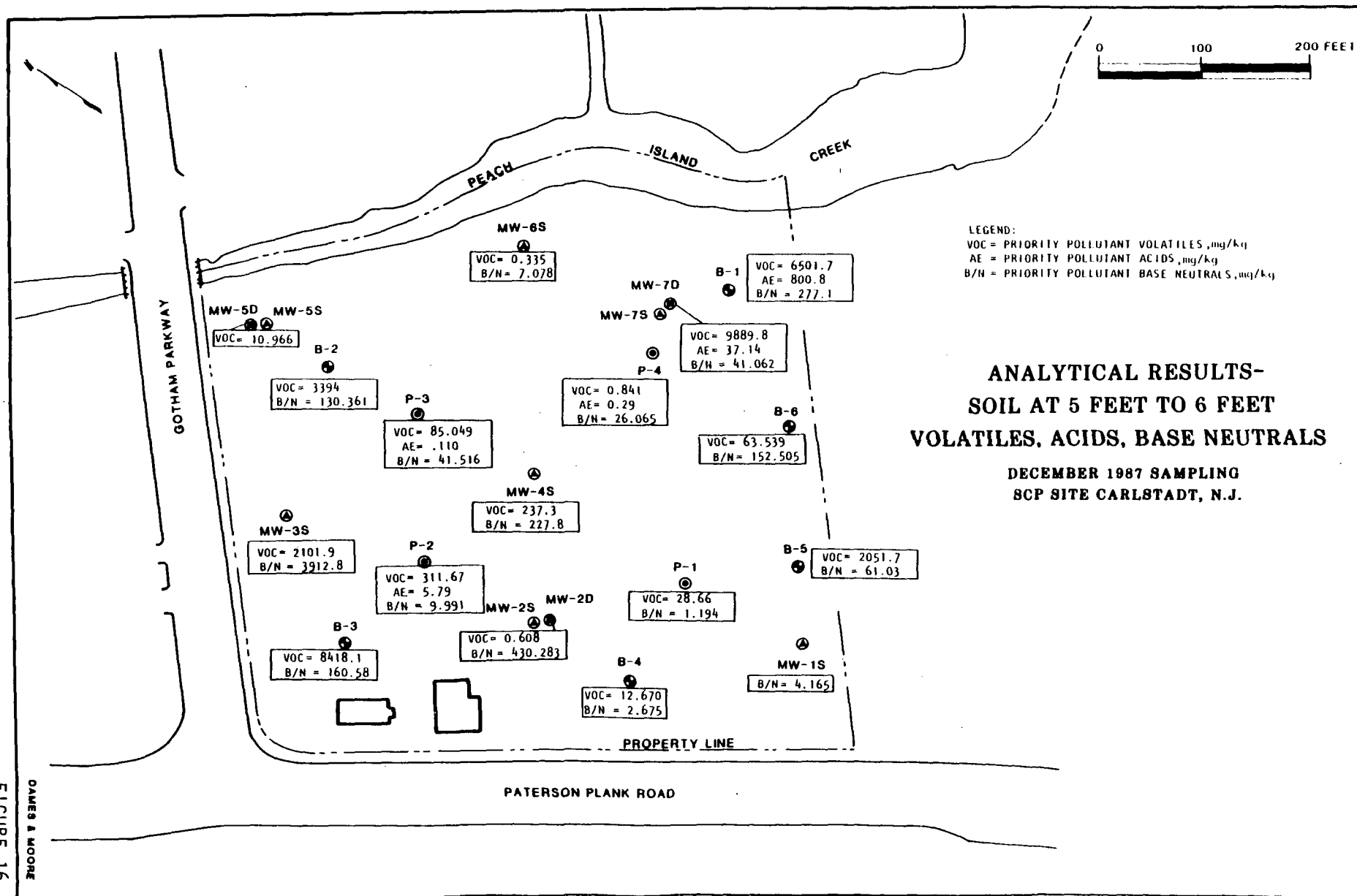
FIGURE 14

DAMES & MOORE

FIGURE 15

DAMES & MOORE

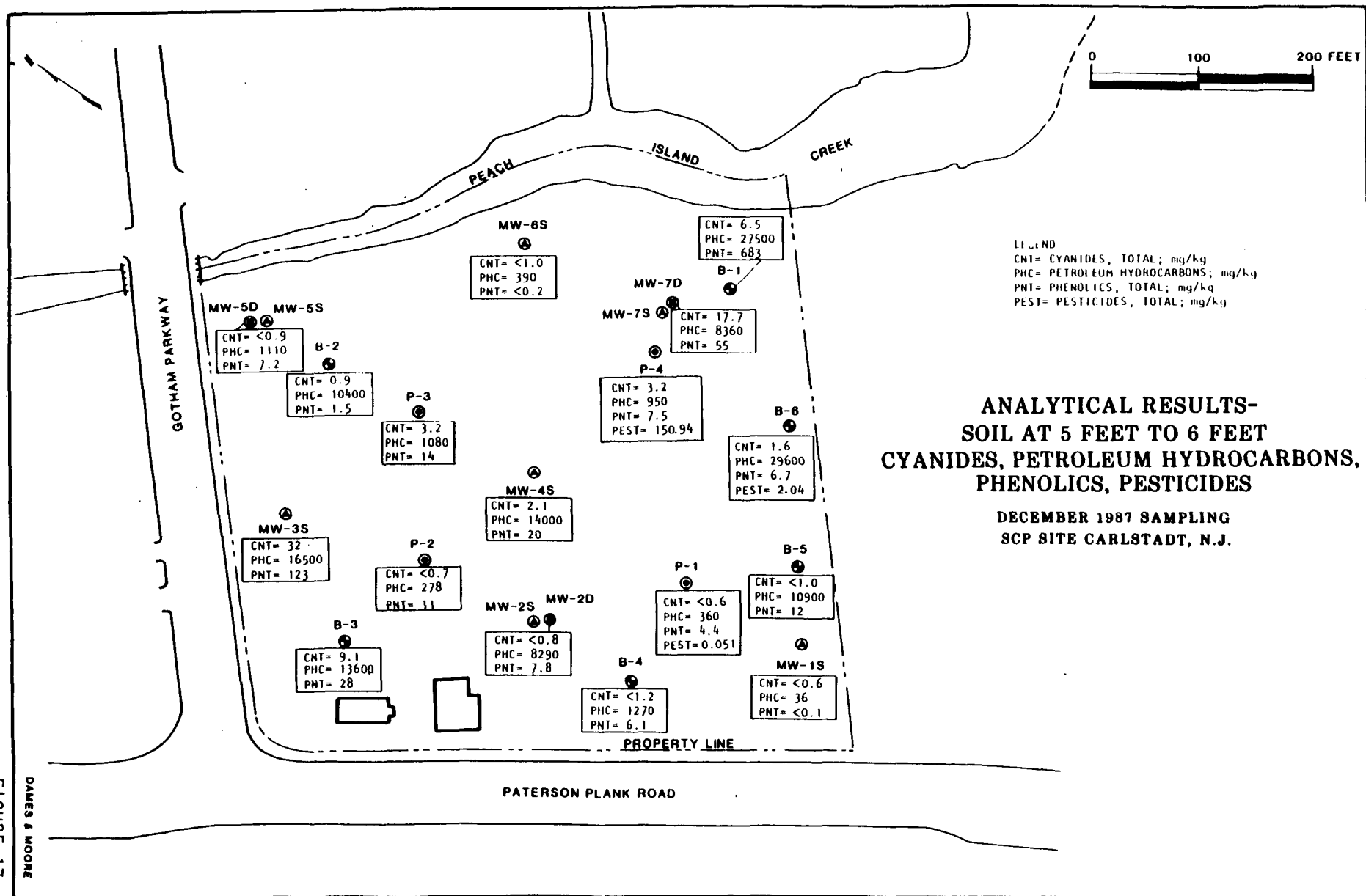




100170

FIGURE 17

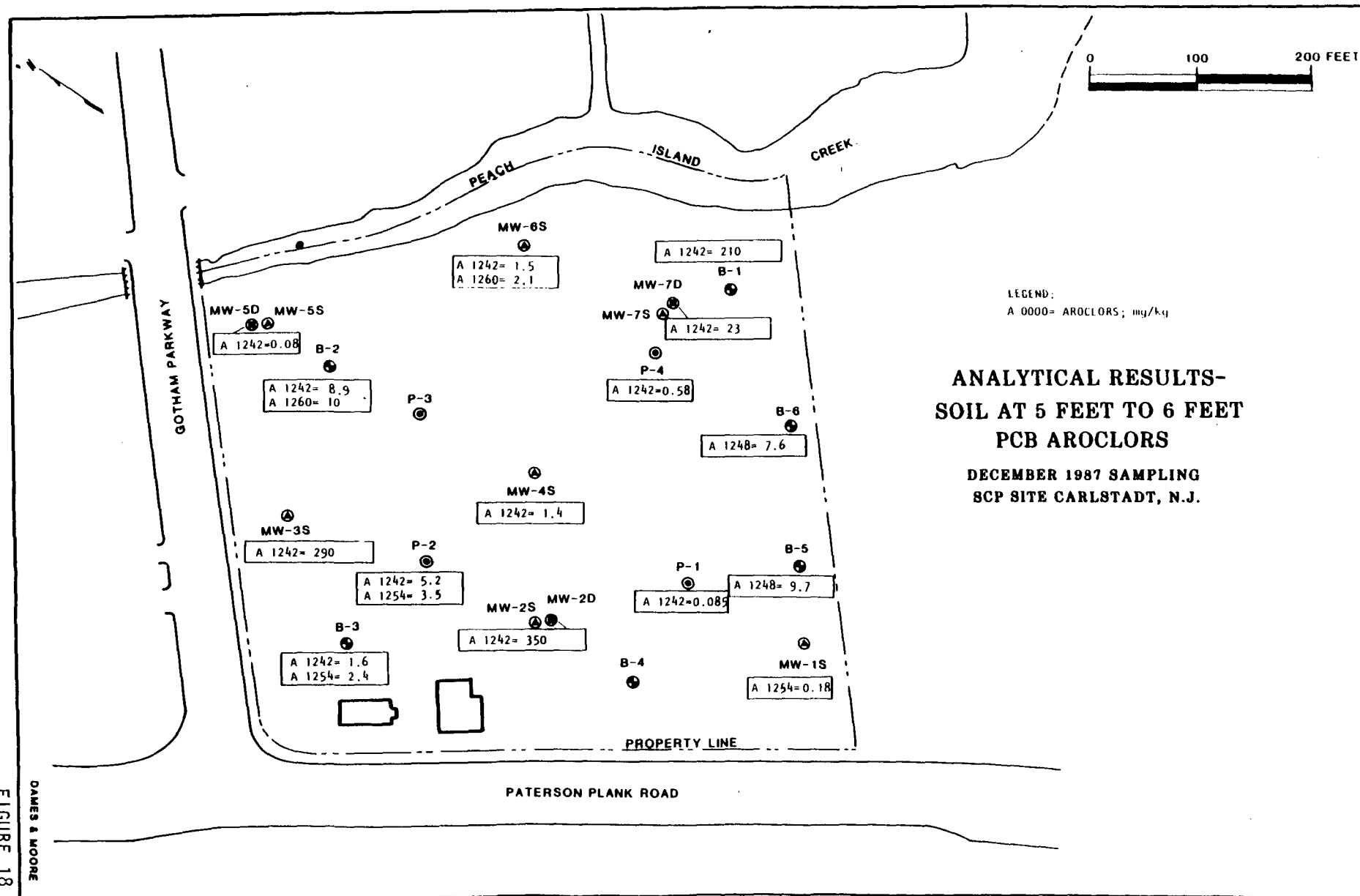
DAMES & MOORE



100171

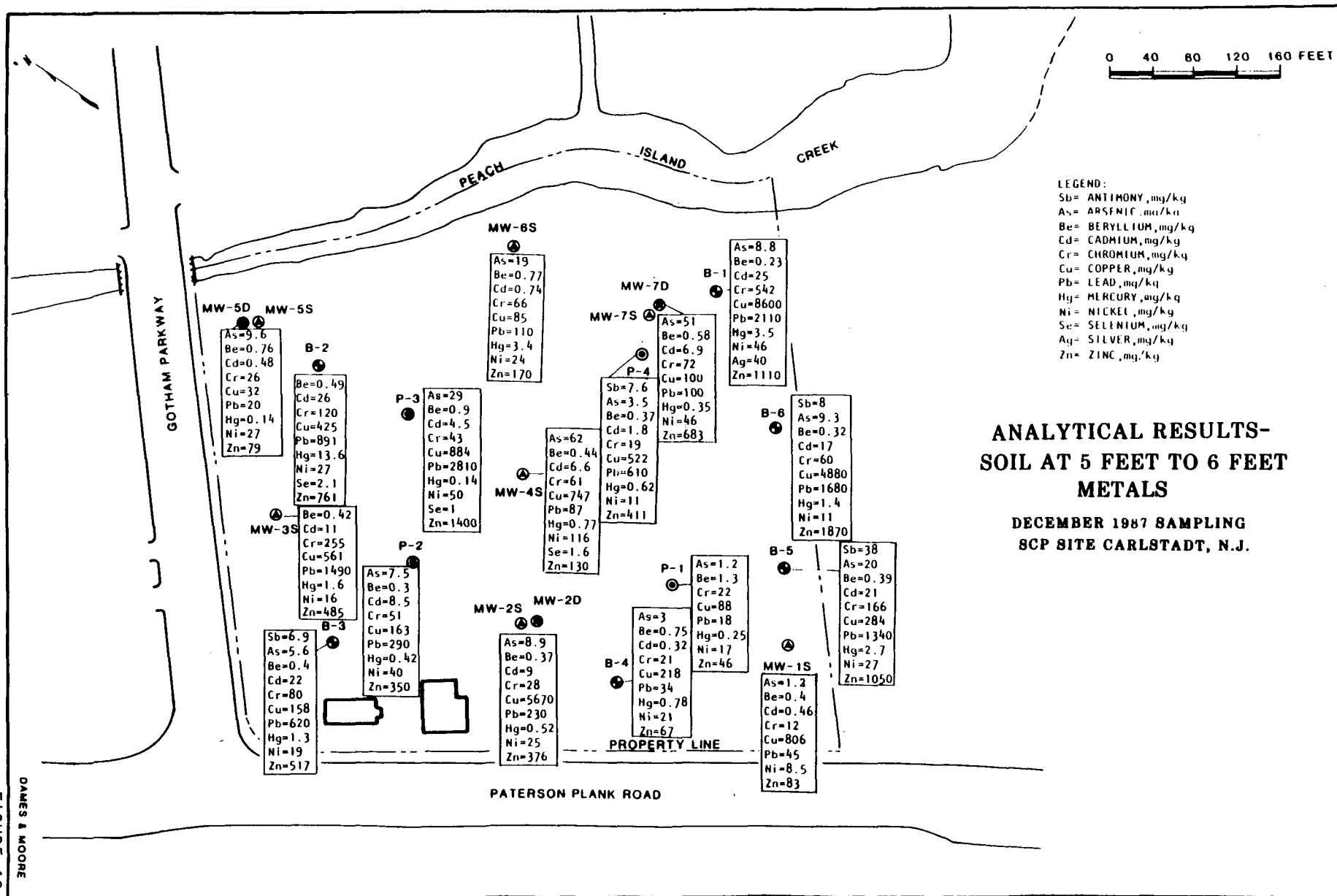
FIGURE 18

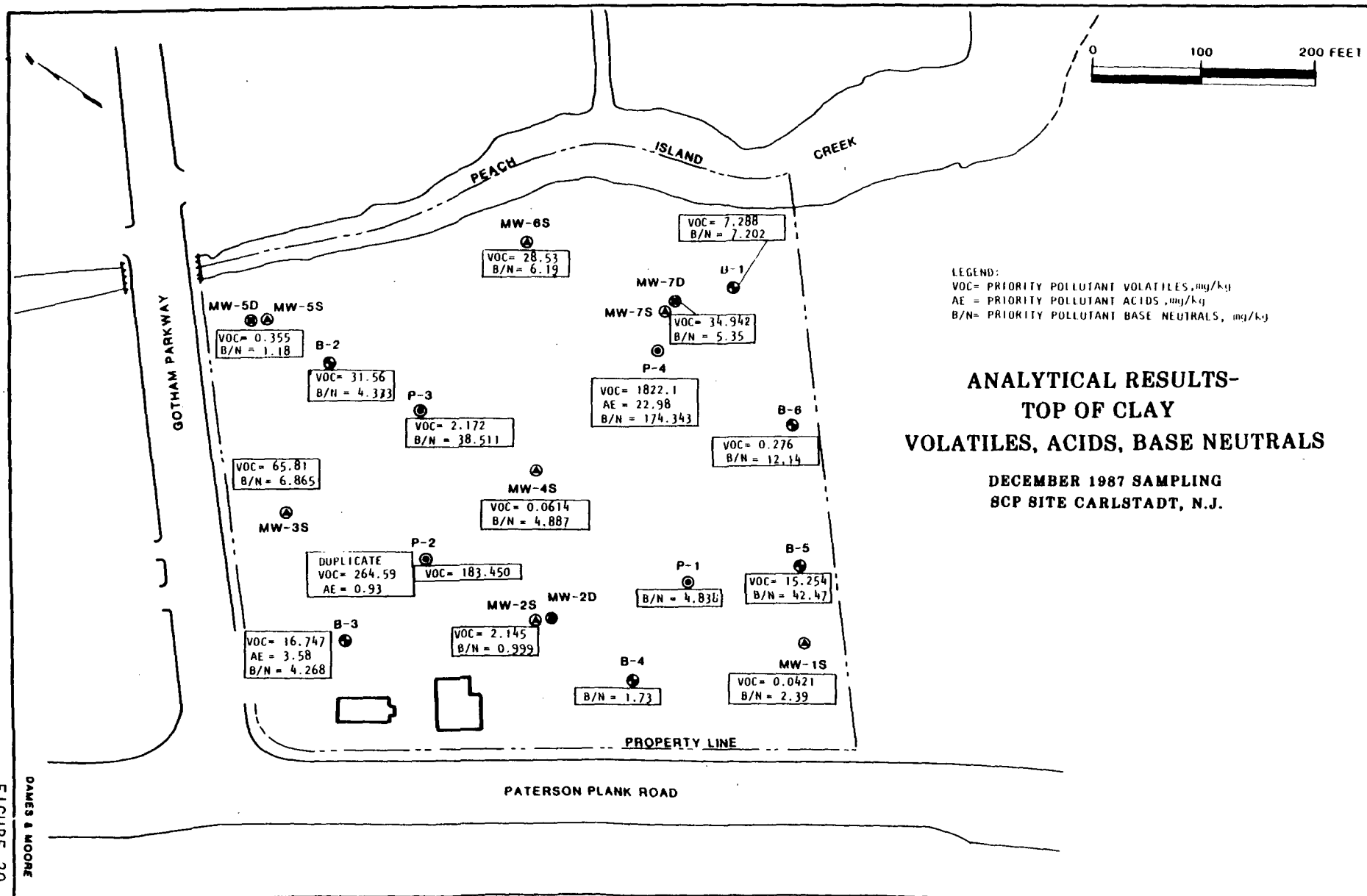
DAMES & MOORE



100172

FIGURE 19





100173

FIGURE 20

DAMES & MOORE

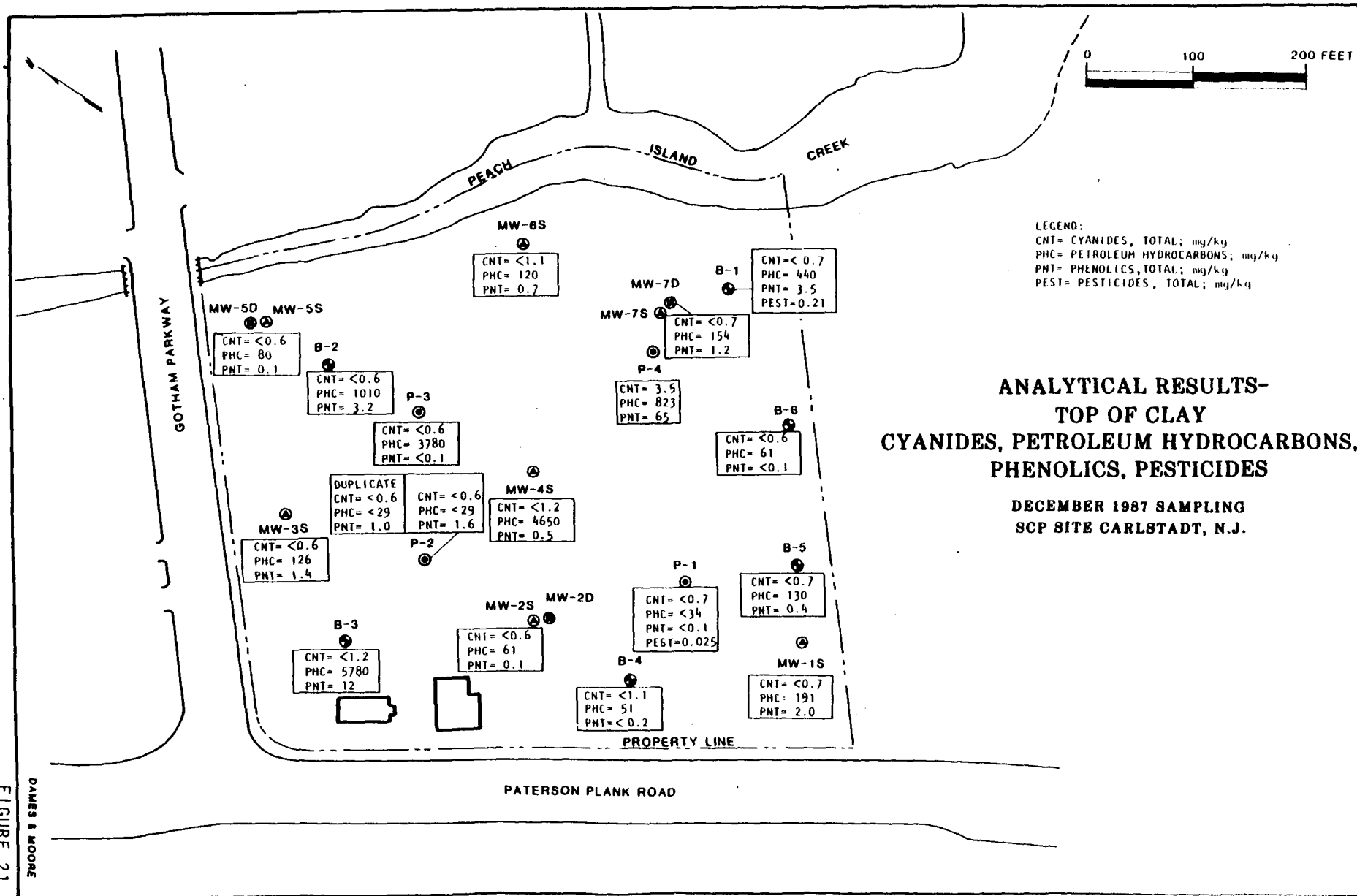


FIGURE 21

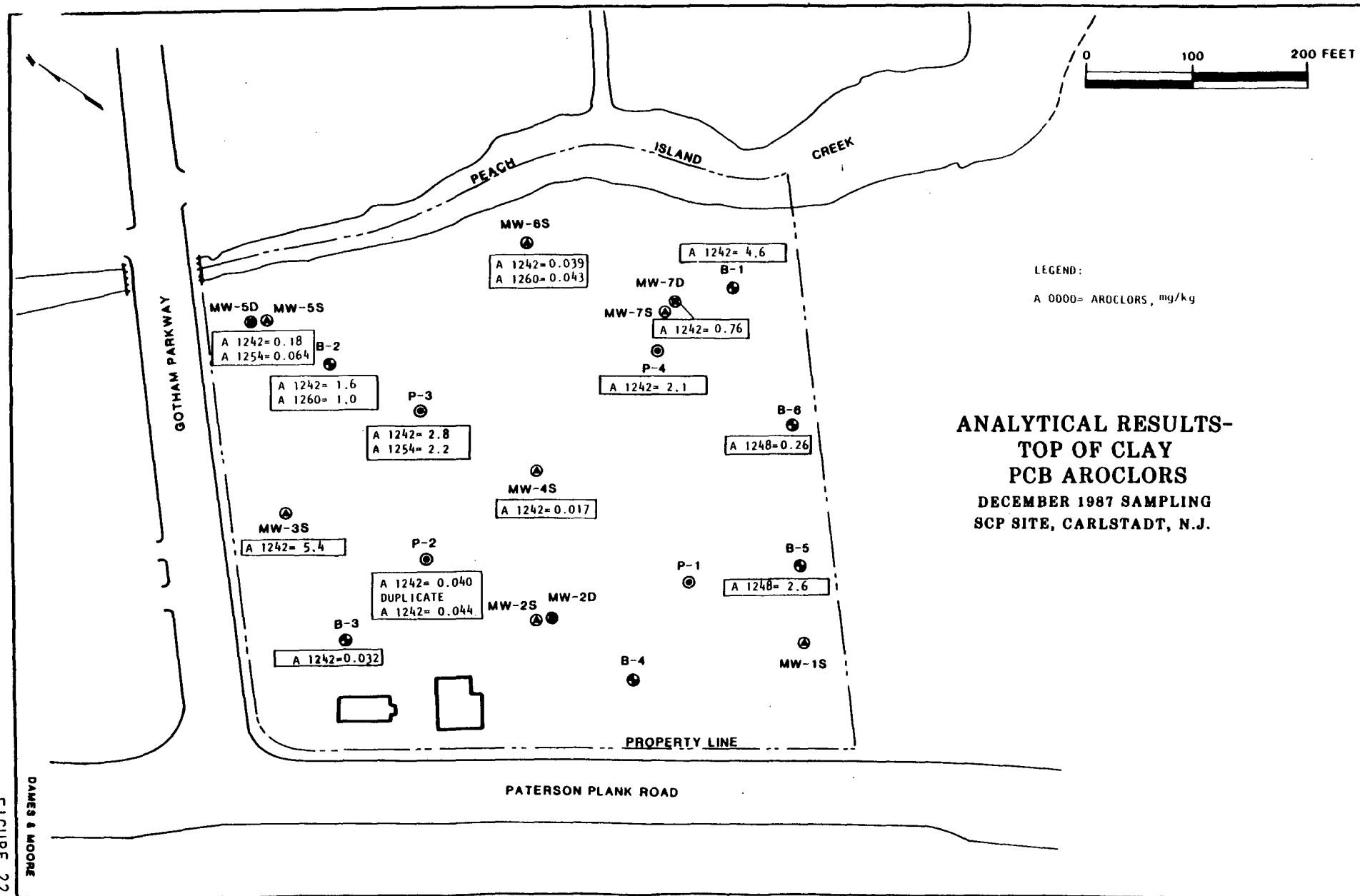
100174



LEGEND:

A 0000= AROCLORS, mg/kg

**ANALYTICAL RESULTS-
TOP OF CLAY
PCB AROCLORS
DECEMBER 1987 SAMPLING
SCP SITE, CARLSTADT, N.J.**



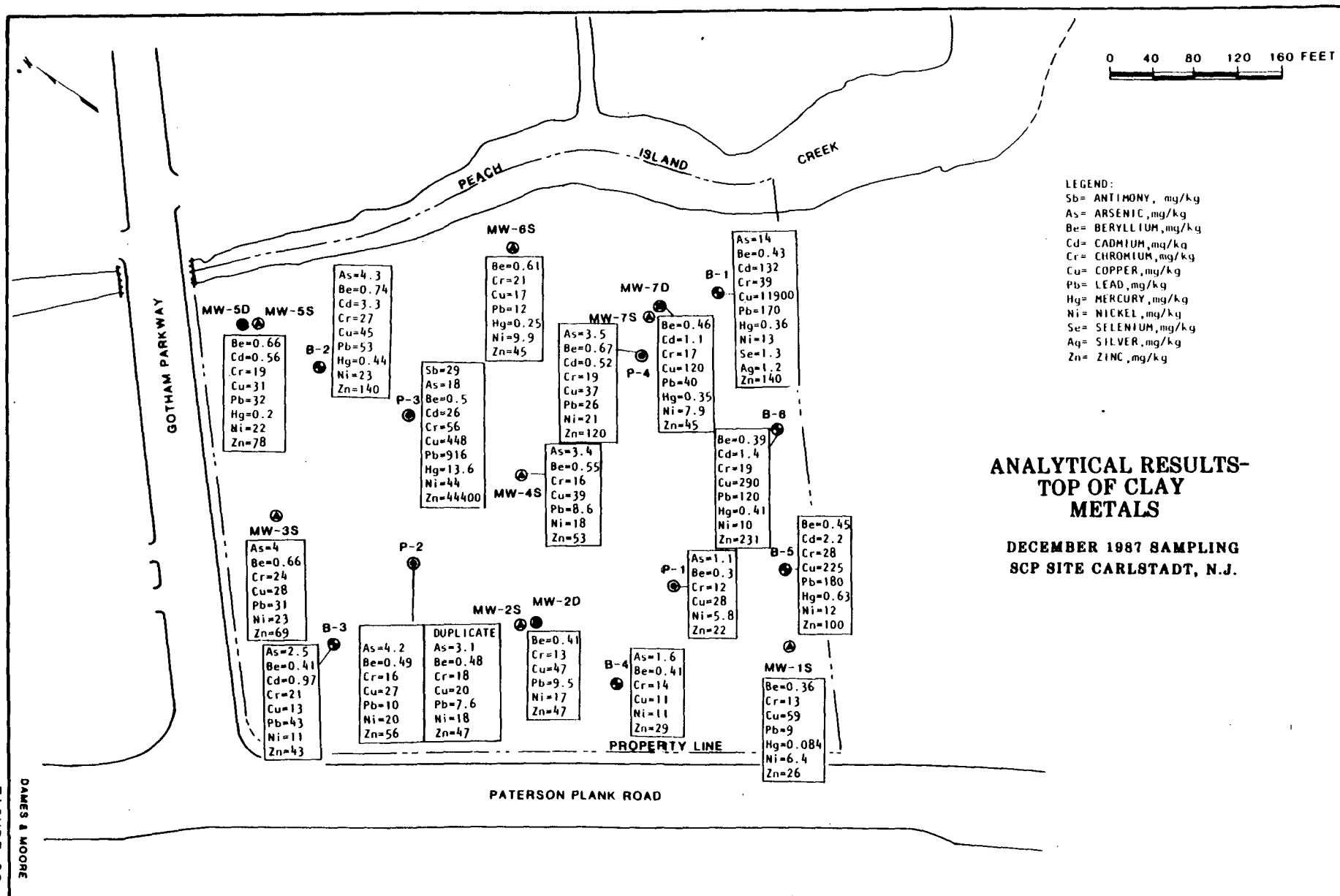
100175

FIGURE 22

DAMES & MOORE

FIGURE 23

DAMES & MOORE



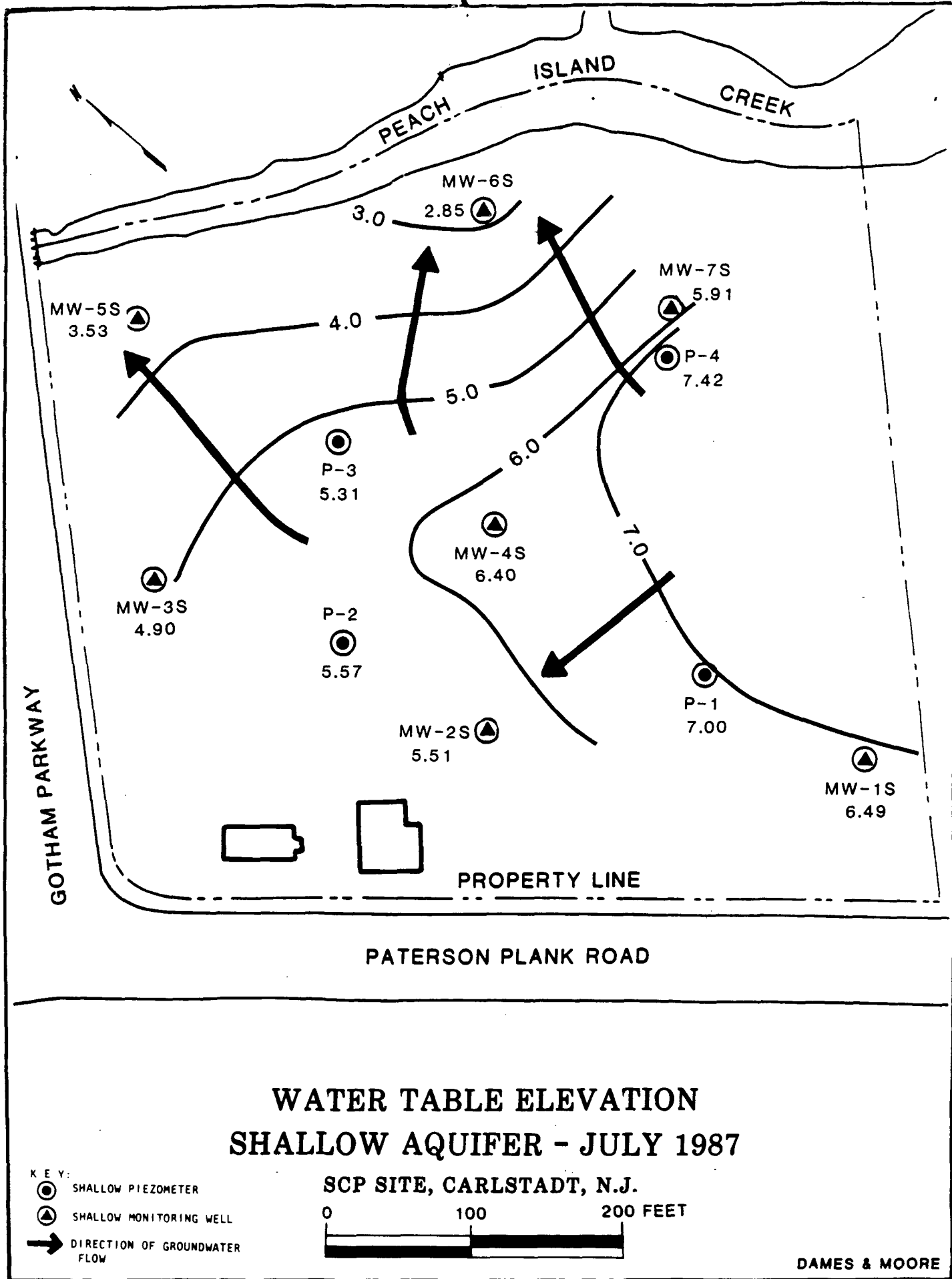


FIGURE 25

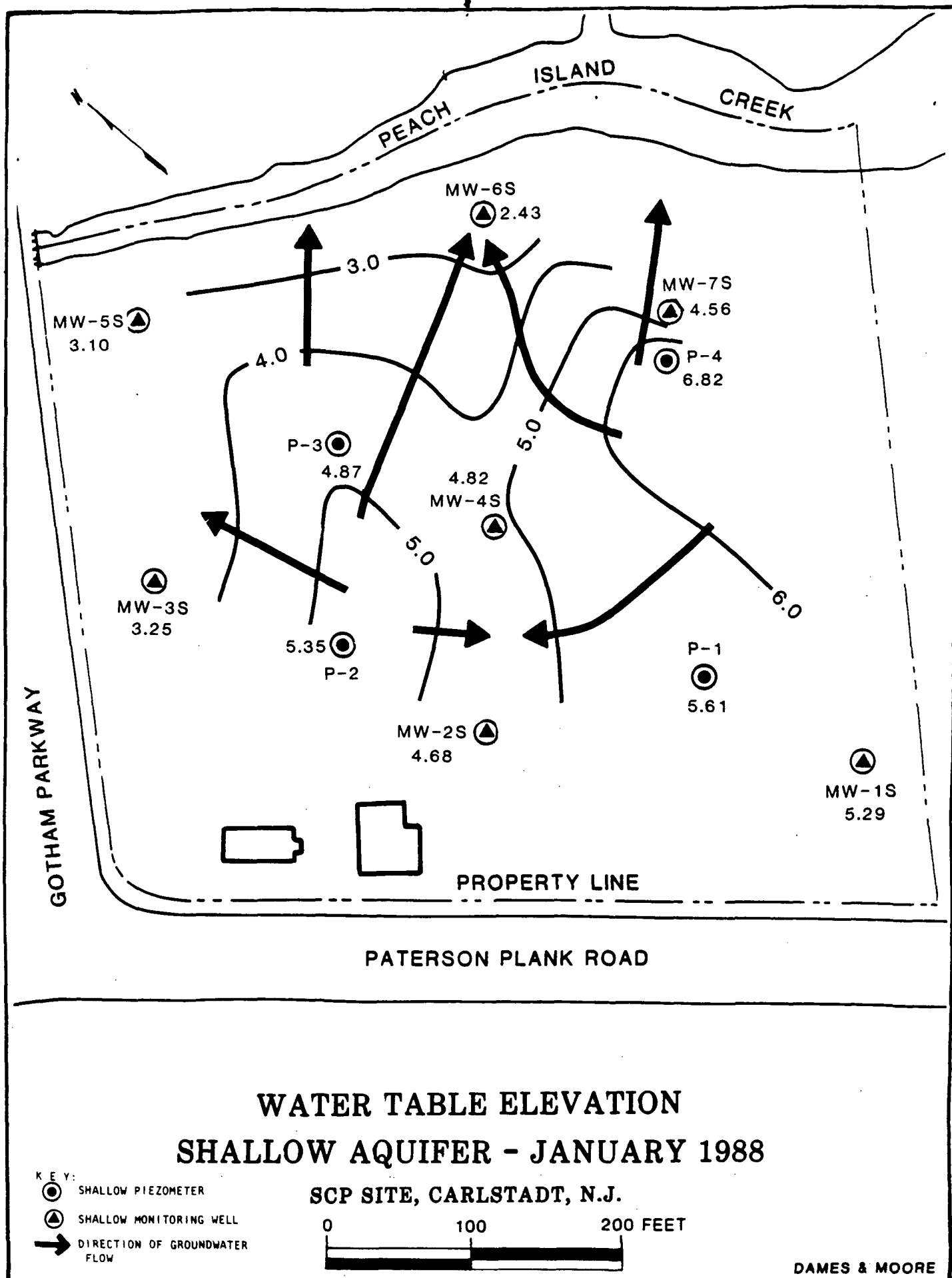
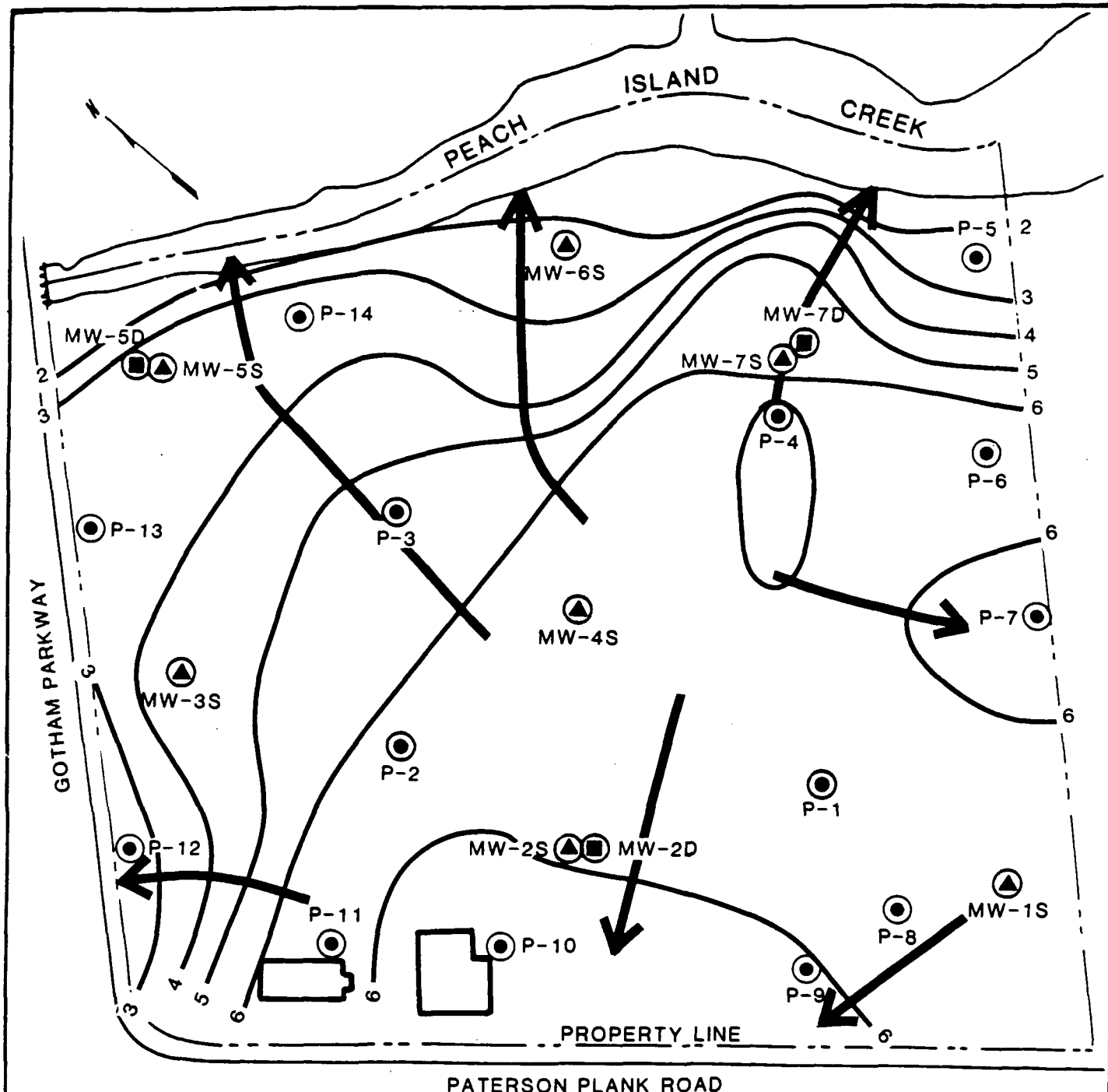
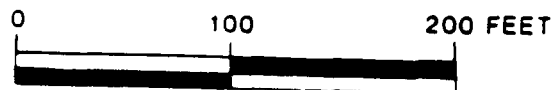


FIGURE 26



WATER TABLE ELEVATION SHALLOW AQUIFER- MARCH 7, 1988

SCP SITE, CARLSTADT, N.J.

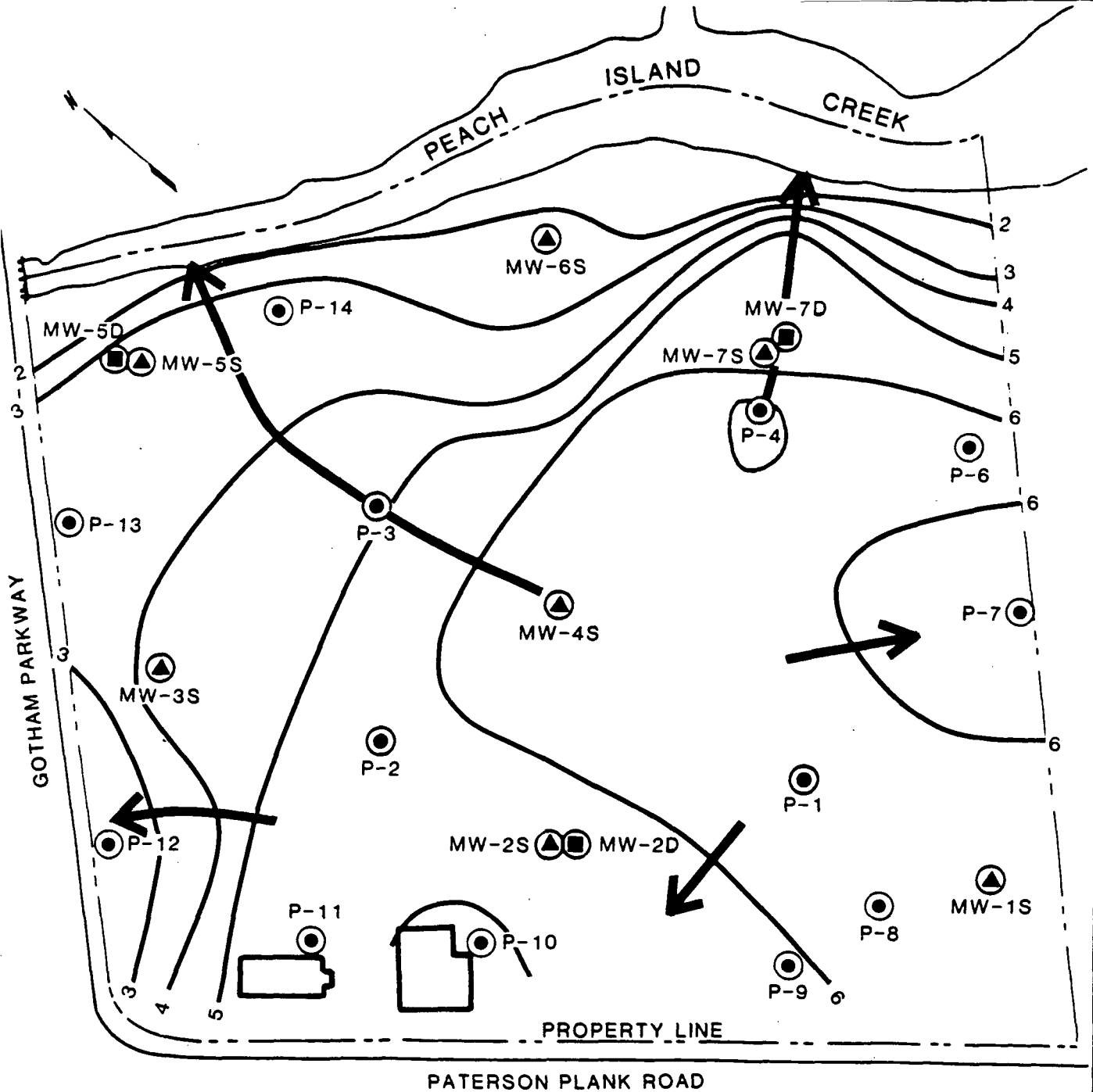


KEY:
 ○ SHALLOW PIEZOMETER
 □ SHALLOW MONITORING WELL
 → DIRECTION OF GROUNDWATER FLOW

DAMES & MOORE

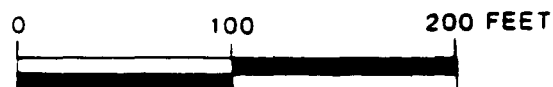
FIGURE 27

100180






WATER TABLE ELEVATION SHALLOW AQUIFER- MARCH 14, 1988

SCP SITE, CARLSTADT, N.J.



KEY:

-  SHALLOW PIEZOMETER
-  SHALLOW MONITORING WELL
-  DIRECTION OF GROUNDWATER FLOW

DAMES & MOORE

FIGURE 28

100181

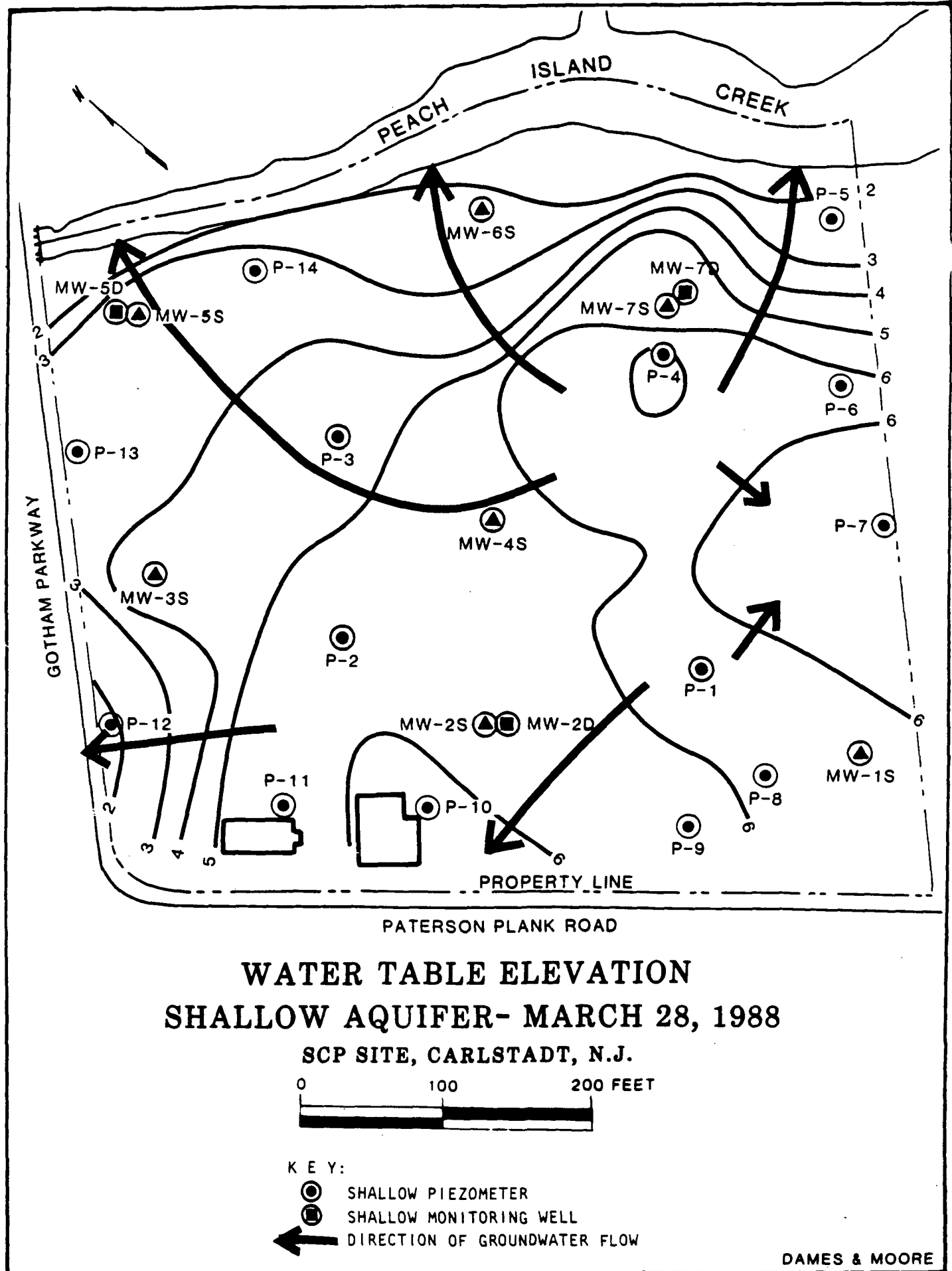
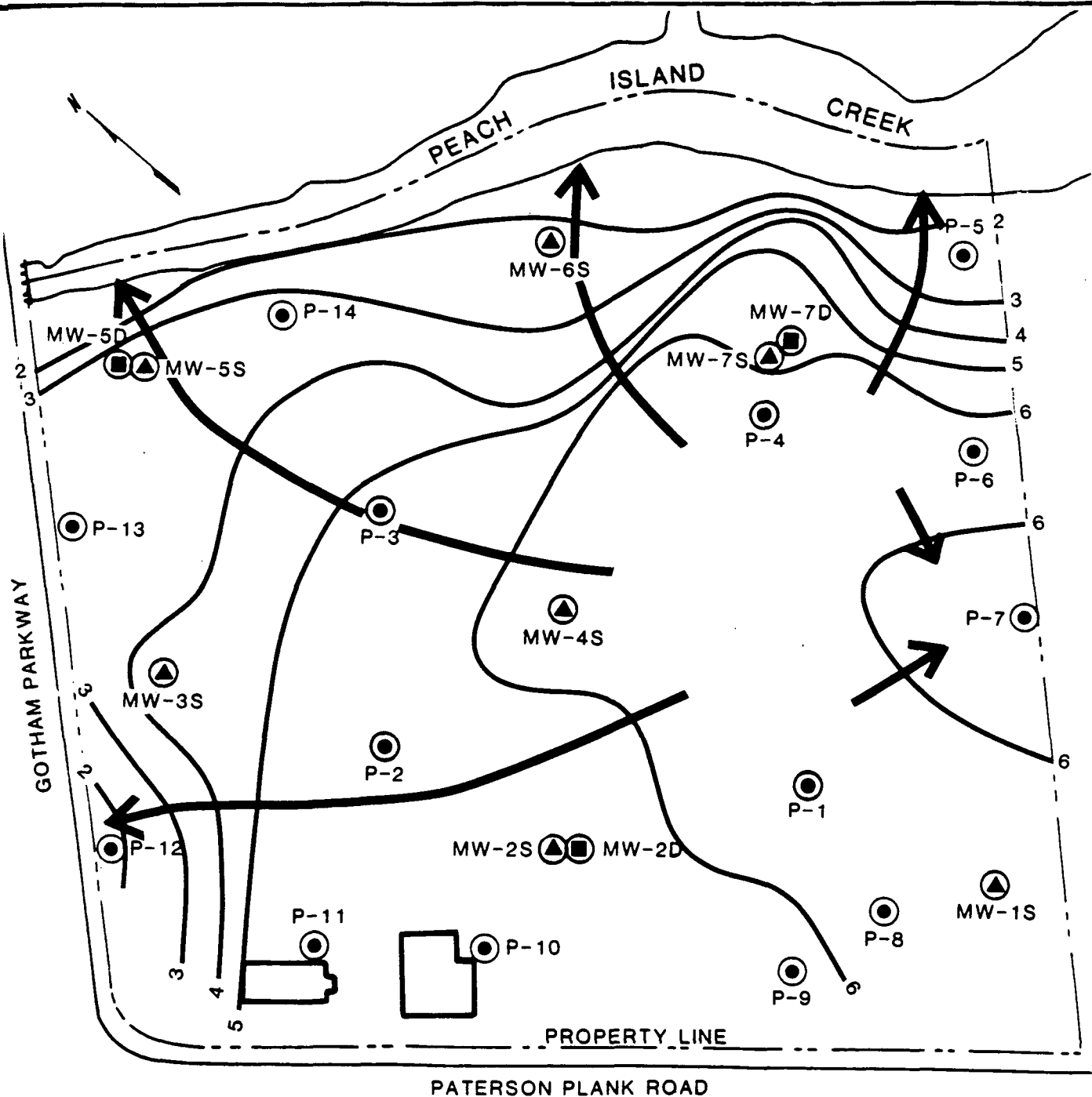
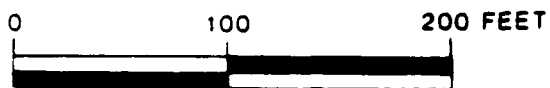


FIGURE 29






WATER TABLE ELEVATION SHALLOW AQUIFER- APRIL 11, 1988

SCP SITE, CARLSTADT, N.J.

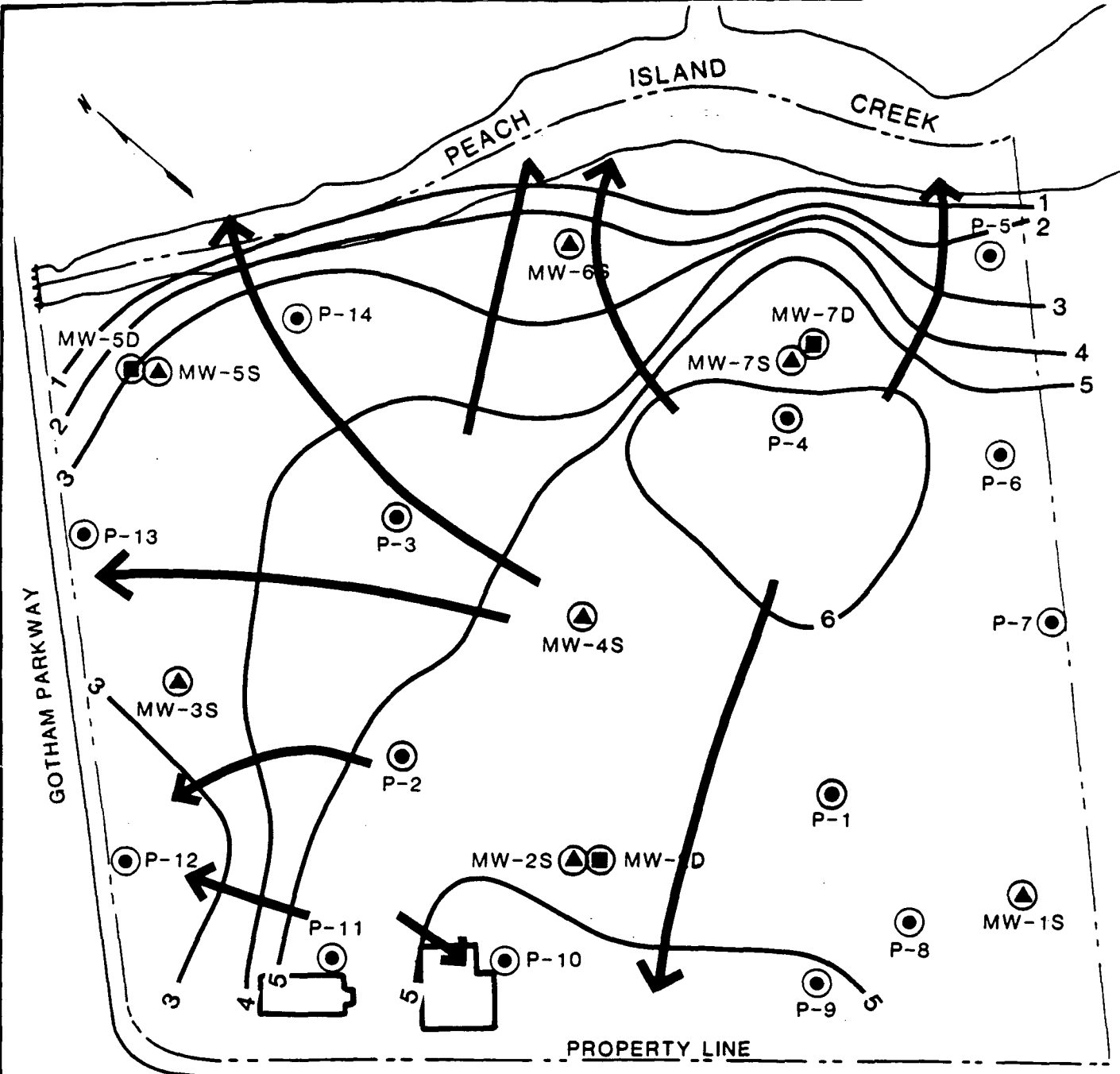


KEY:

-  SHALLOW PIEZOMETER
-  SHALLOW MONITORING WELL
-  DIRECTION OF GROUNDWATER FLOW

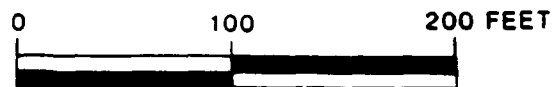
DAMES & MOORE

FIGURE 30



WATER TABLE ELEVATION SHALLOW TILL AQUIFER- APRIL 25, 1988

SCP SITE, CARLSTADT, N.J.

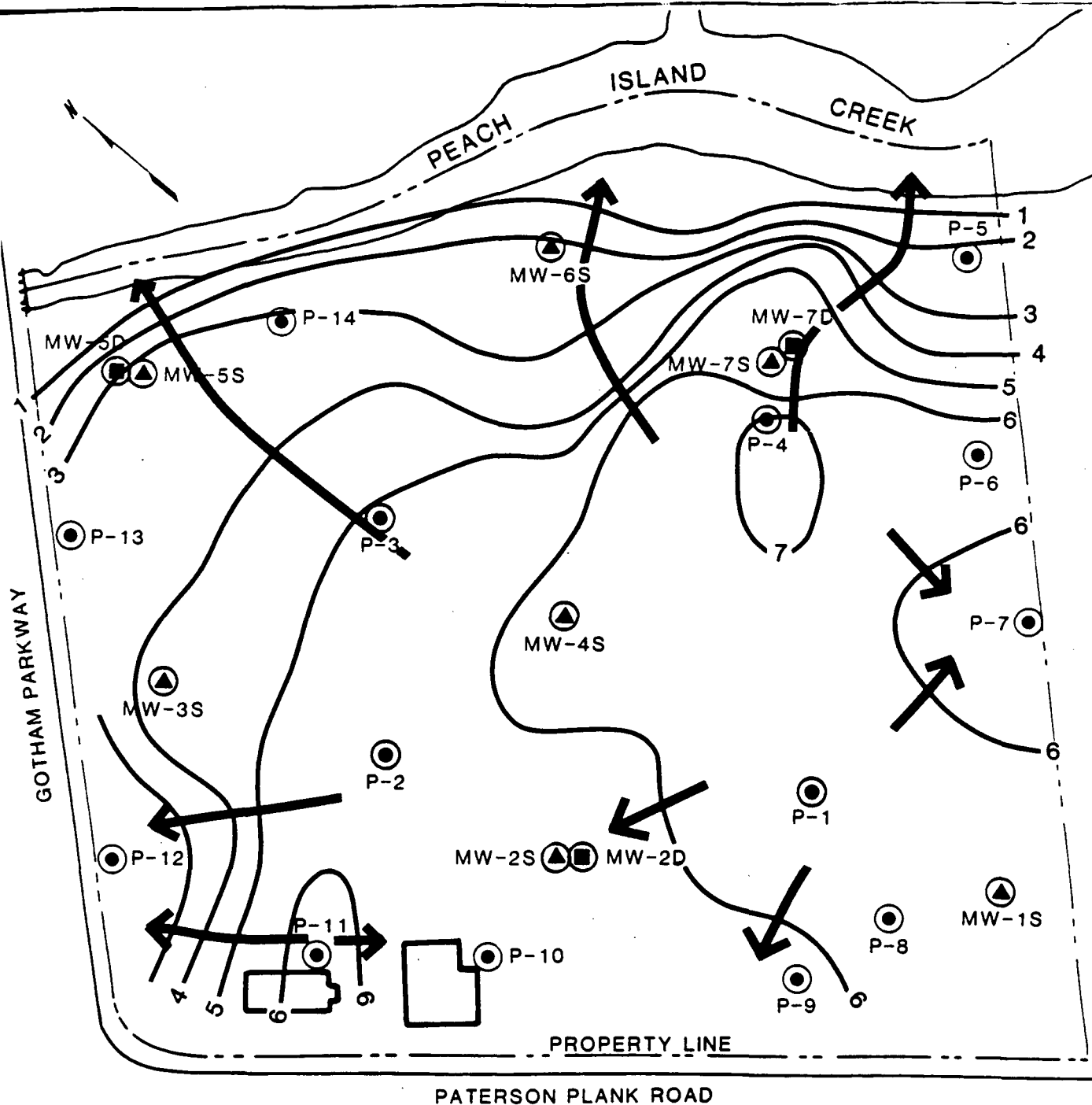


KEY:

- SHALLOW PIEZOMETER
- SHALLOW MONITORING WELL
- DIRECTION OF GROUNDWATER FLOW

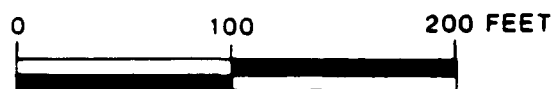
DAMES & MOORE

FIGURE 31



WATER TABLE ELEVATION SHALLOW TILL AQUIFER- MAY 9, 1988

SCP SITE, CARLSTADT, N.J.



KEY:

- SHALLOW PIEZOMETER
- ◼ SHALLOW MONITORING WELL
- ← DIRECTION OF GROUNDWATER FLOW

DAMES & MOORE

FIGURE 32

100185

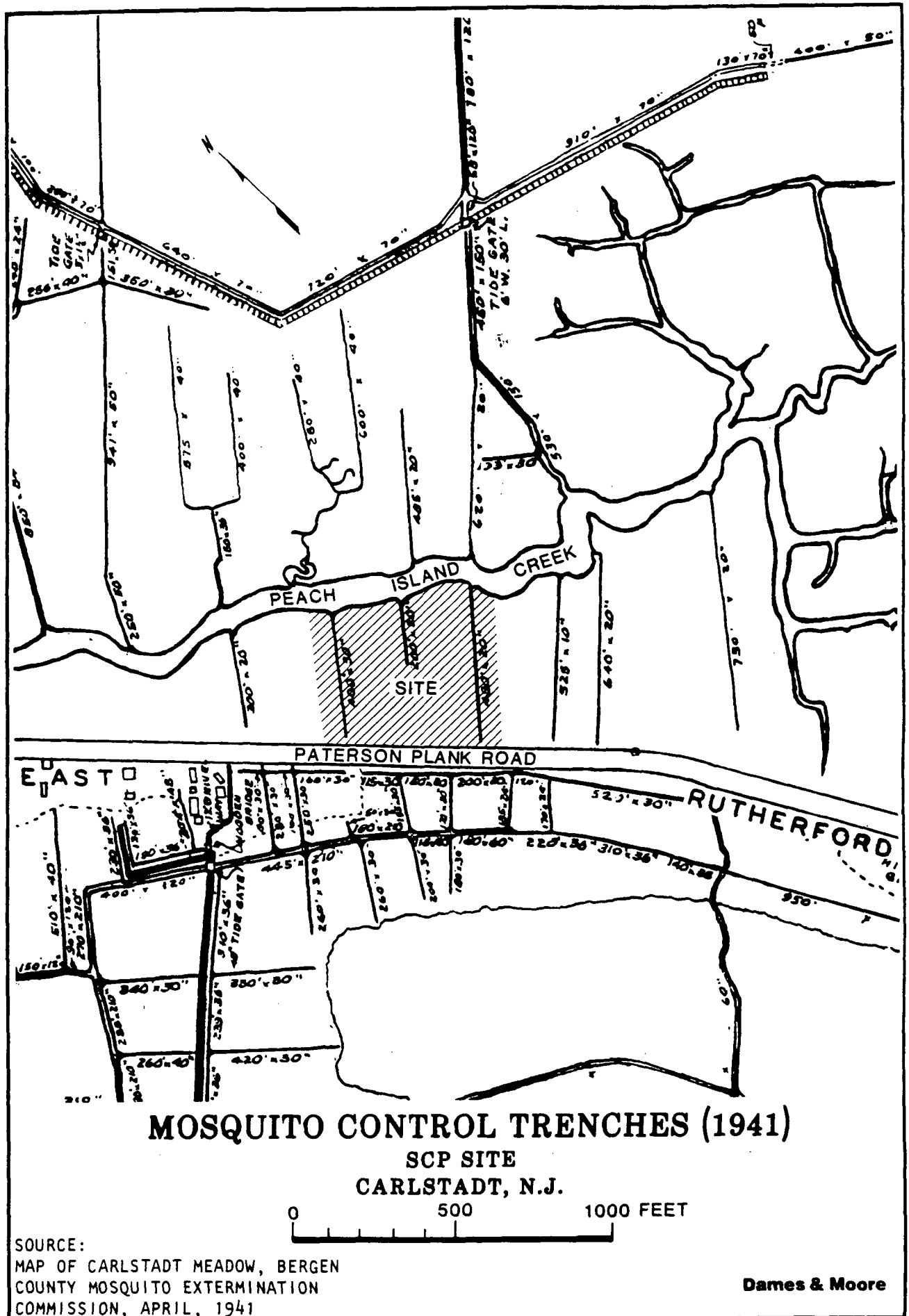


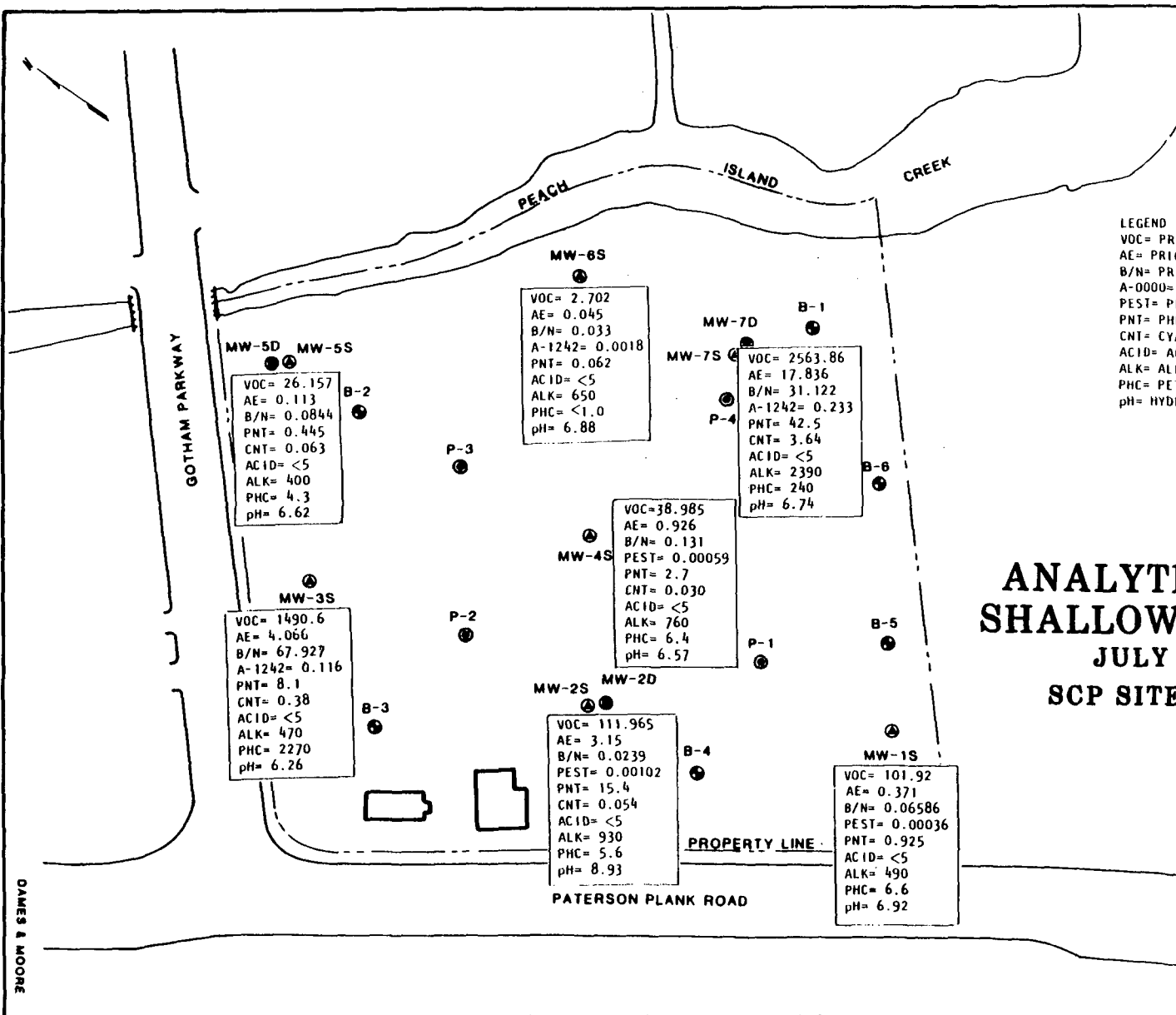
FIGURE 33

1 ppm
= 1000 ppb

0 40 80 120 160 FEET

LEGEND
 VOC= PRIORITY POLLUTANT VOLATILES; mg/l
 AE= PRIORITY POLLUTANT ACIDS; mg/l
 B/N= PRIORITY POLLUTANT BASE NEUTRALS; mg/l
 A-0000= AROCLOMS; mg/l
 PEST= PESTICIDES; mg/l
 PNT= PHENOLICS, TOTAL; mg/l
 CNT= CYANIDES, TOTAL; mg/l
 ACID= ACIDITY AS CaCO₃; mg/l
 ALK= ALKALINITY AS CaCO₃; mg/l
 PHC= PETROLEUM HYDROCARBONS; mg/l
 pH= HYDROGEN ION CONCENTRATION; std.

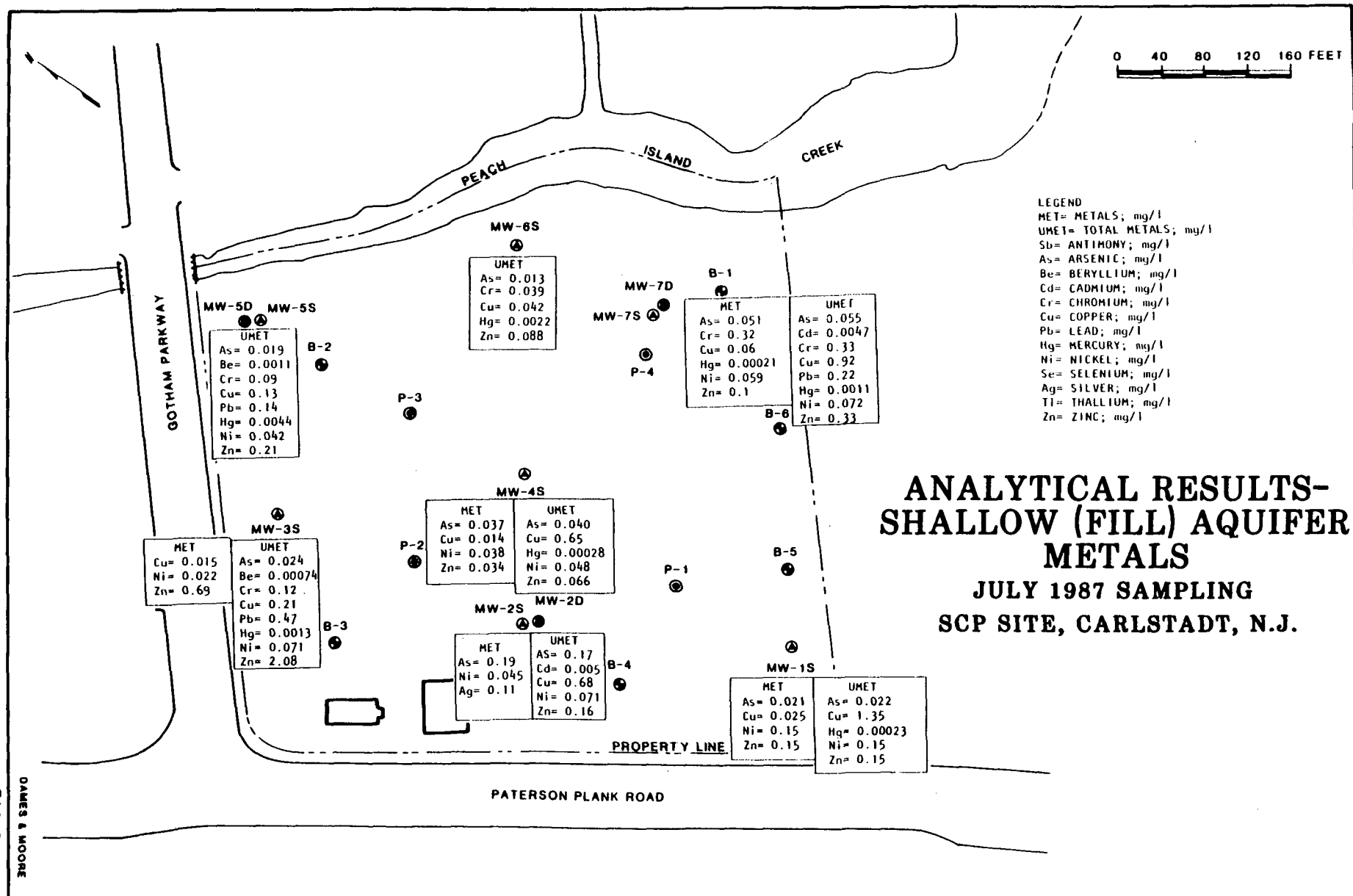
ANALYTICAL RESULTS- SHALLOW (FILL) AQUIFER JULY 1987 SAMPLING SCP SITE, CARLSTADT, N.J.

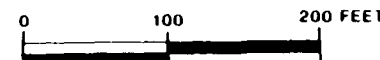


100187

FIGURE 34

DAMES & MOORE



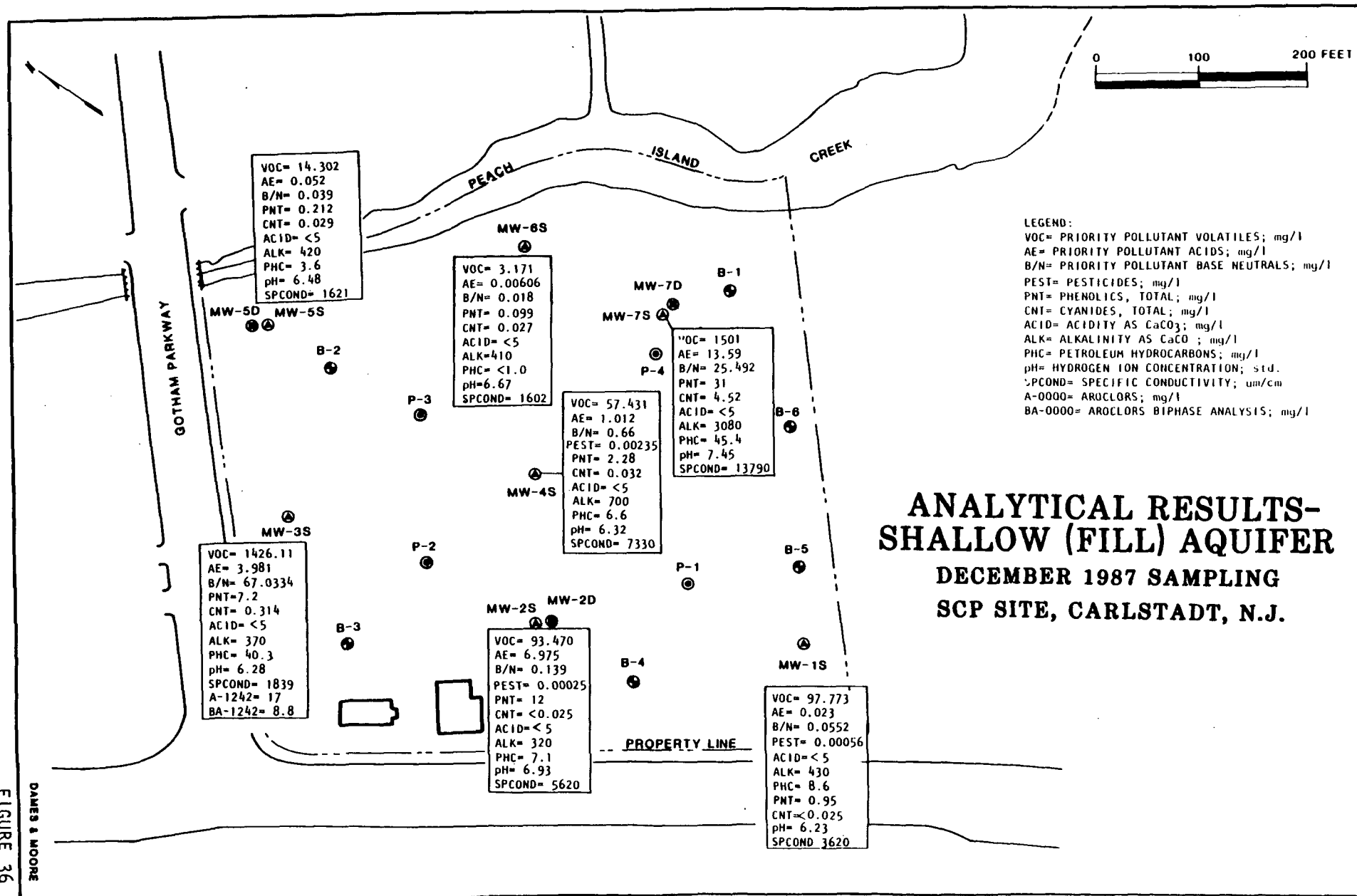


LEGEND:
 VOC= PRIORITY POLLUTANT VOLATILES; mg/l
 AE= PRIORITY POLLUTANT ACIDS; mg/l
 B/N= PRIORITY POLLUTANT BASE NEUTRALS; mg/l
 PEST= PESTICIDES; mg/l
 PNT= PHENOLICS, TOTAL; mg/l
 CNT= CYANIDES, TOTAL; mg/l
 ACID= ACIDITY AS CaCO₃; mg/l
 ALK= ALKALINITY AS CaCO₃; mg/l
 PHC= PETROLEUM HYDROCARBONS; mg/l
 pH= HYDROGEN ION CONCENTRATION; std.
 SPCOND= SPECIFIC CONDUCTIVITY; um/cm
 A-0000= AROCLORS; mg/l
 BA-0000= AROCLORS BIPHASE ANALYSIS; mg/l

ANALYTICAL RESULTS- SHALLOW (FILL) AQUIFER

DECEMBER 1987 SAMPLING

SCP SITE, CARLSTADT, N.J.



100189

FIGURE 36

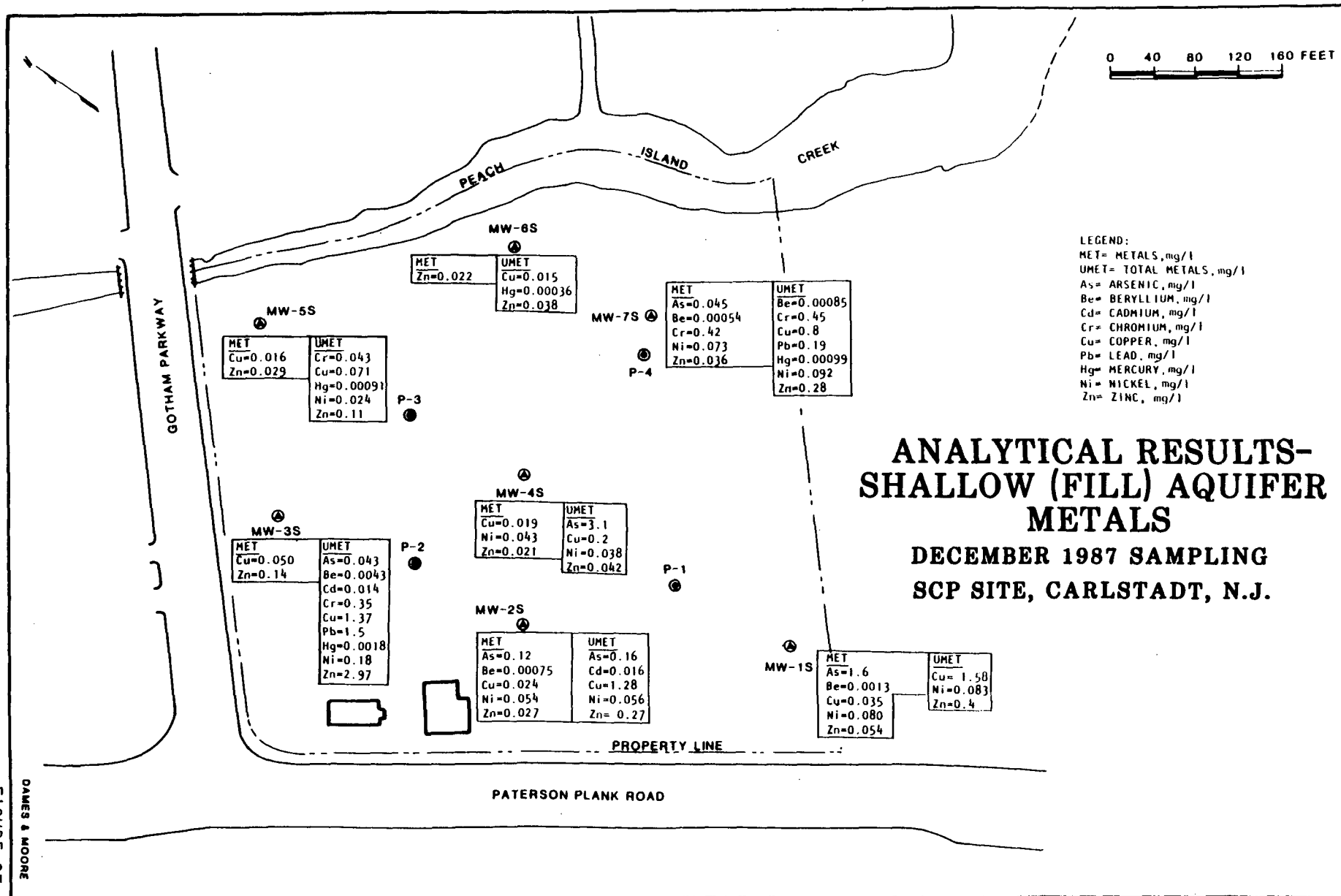
DAMES & MOORE

0 40 80 120 160 FEET

LEGEND:
 MET= METALS, mg/l
 UMET= TOTAL METALS, mg/l
 As= ARSENIC, mg/l
 Be= BERYLLIUM, mg/l
 Cd= CADMIUM, mg/l
 Cr= CHROMIUM, mg/l
 Cu= COPPER, mg/l
 Pb= LEAD, mg/l
 Hg= MERCURY, mg/l
 Ni= NICKEL, mg/l
 Zn= ZINC, mg/l

ANALYTICAL RESULTS- SHALLOW (FILL) AQUIFER METALS

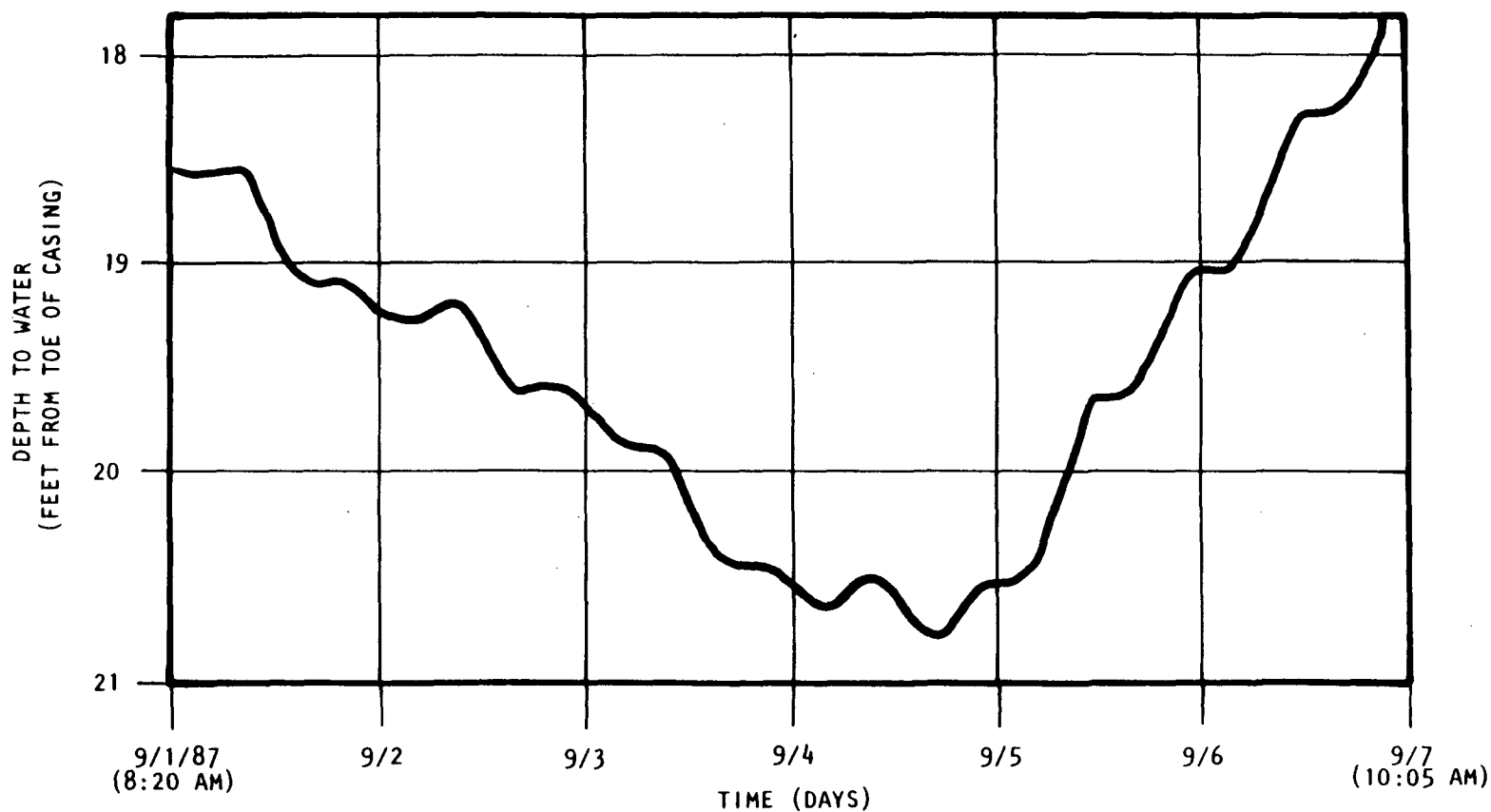
DECEMBER 1987 SAMPLING
SCP SITE, CARLSTADT, N.J.



DAMES & MOORE

FIGURE 37

100190



**TYPICAL HYDROGRAPH OF
TILL AQUIFER (MW-5D)
SCP SITE, CARLSTADT, N.J.**

DAMES & MOORE

FIGURE 38

100191

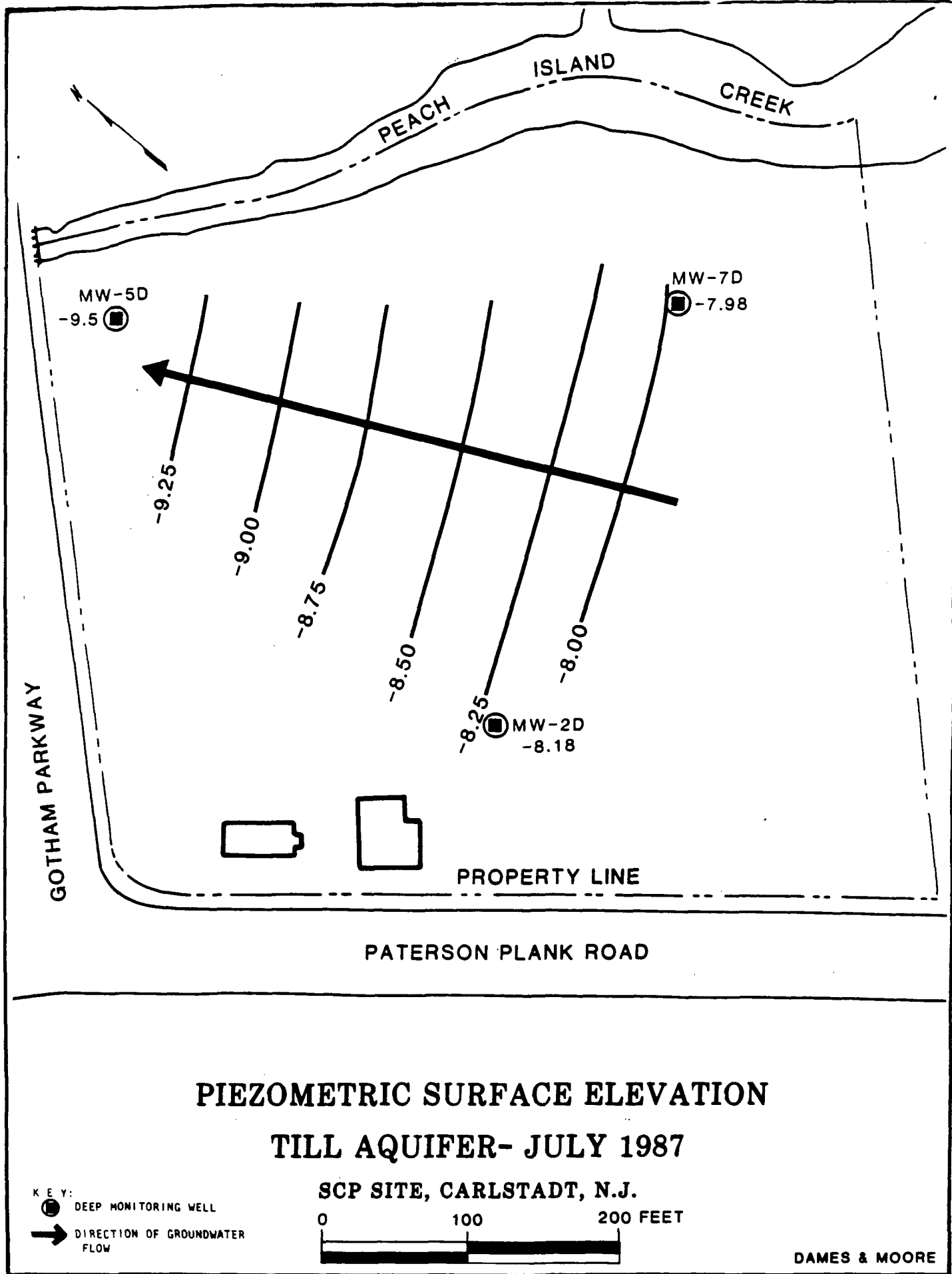
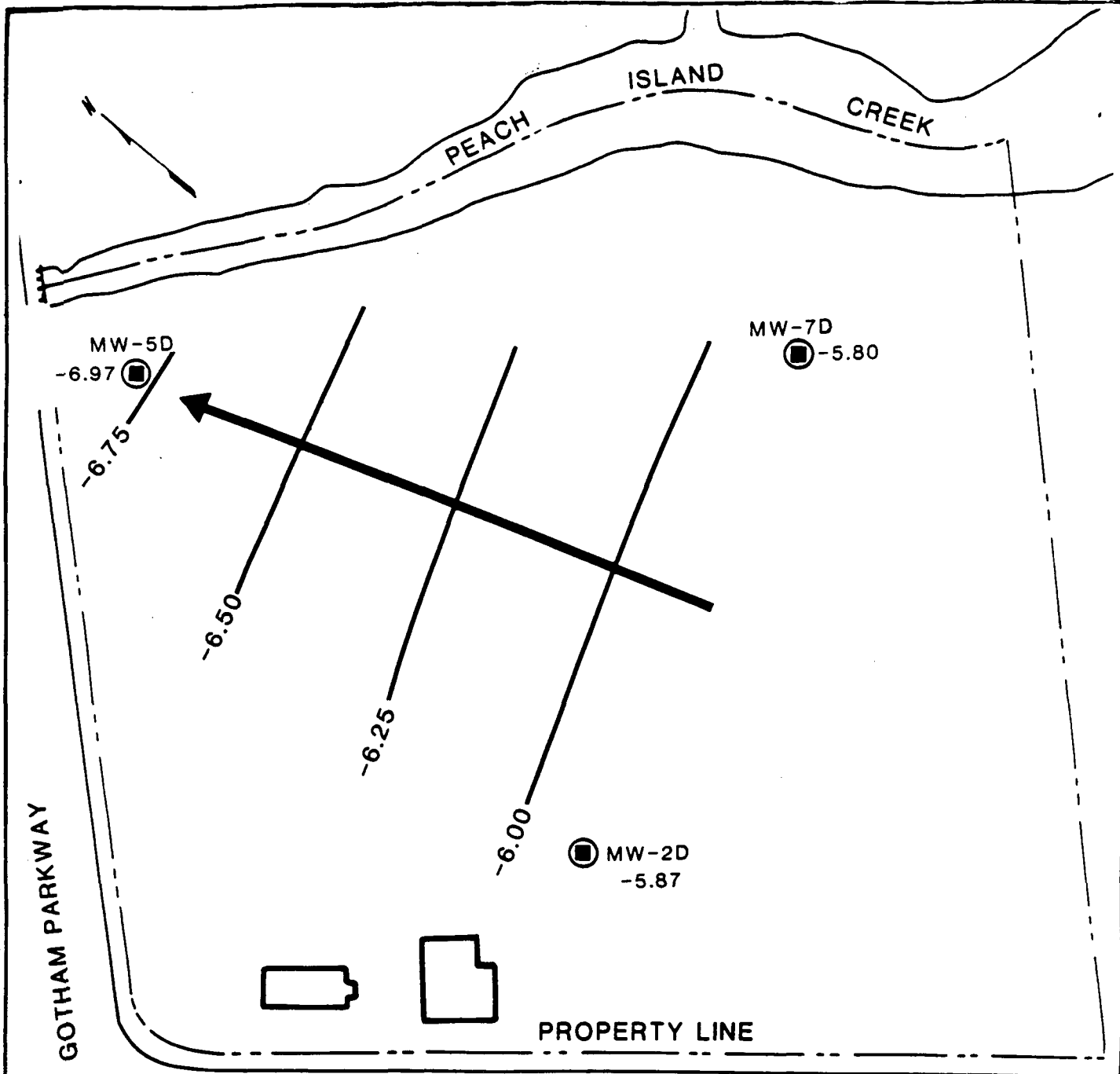


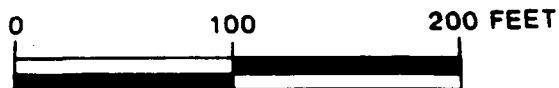
FIGURE 39



PIEZOMETRIC SURFACE ELEVATION TILL AQUIFER- JANUARY 1988

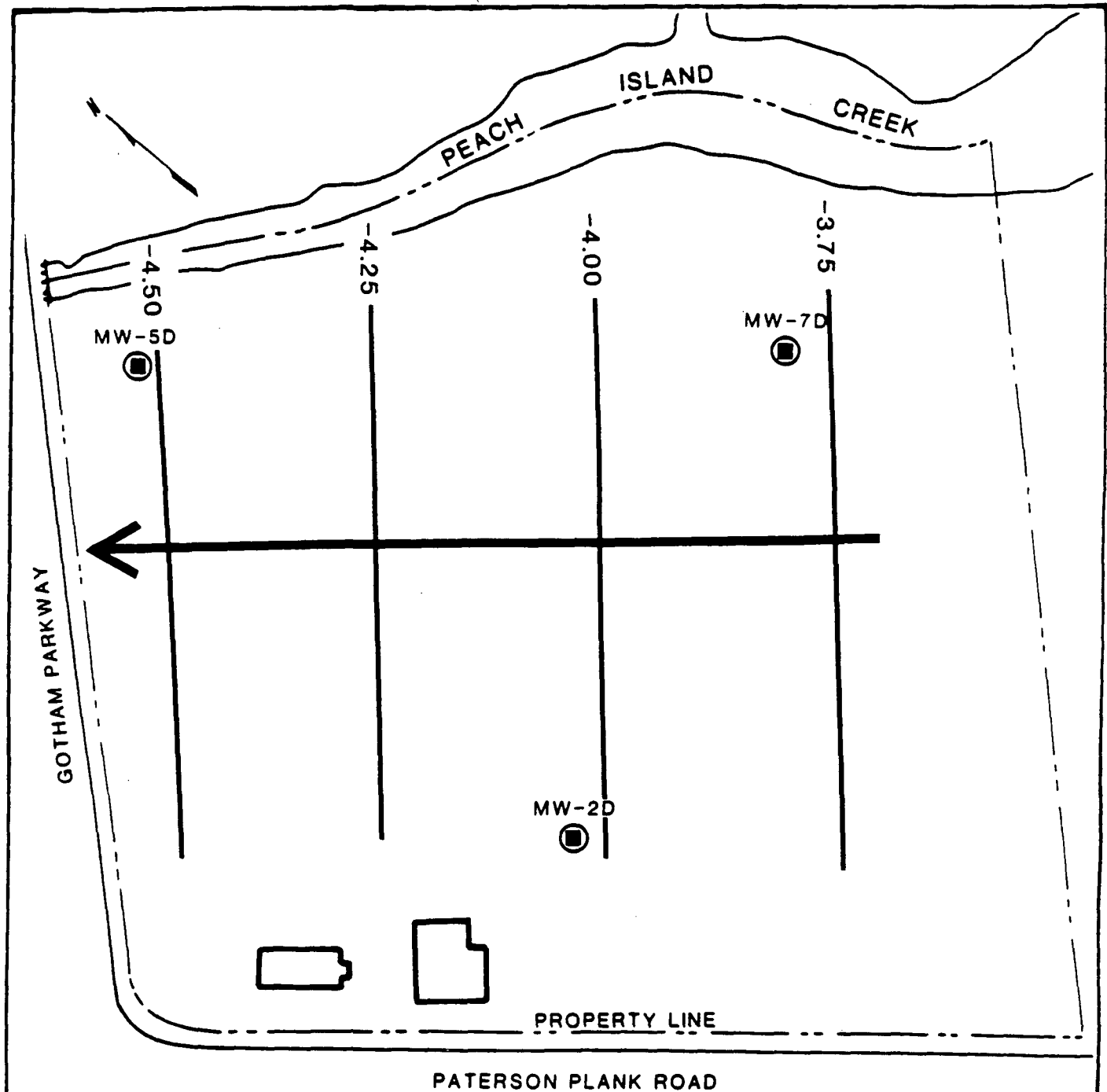
SCP SITE, CARLSTADT, N.J.

KEY:
● DEEP MONITORING WELL
→ DIRECTION OF GROUNDWATER FLOW



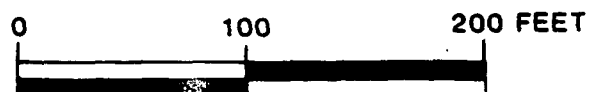
DAMES & MOORE

FIGURE 40



**PIEZOMETRIC SURFACE ELEVATION
TILL AQUIFER- MARCH 7, 1988**

SCP SITE, CARLSTADT, N.J.



KEY:



DEEP MONITORING WELL



DIRECTION OF GROUNDWATER FLOW

DAMES & MOORE

FIGURE 41

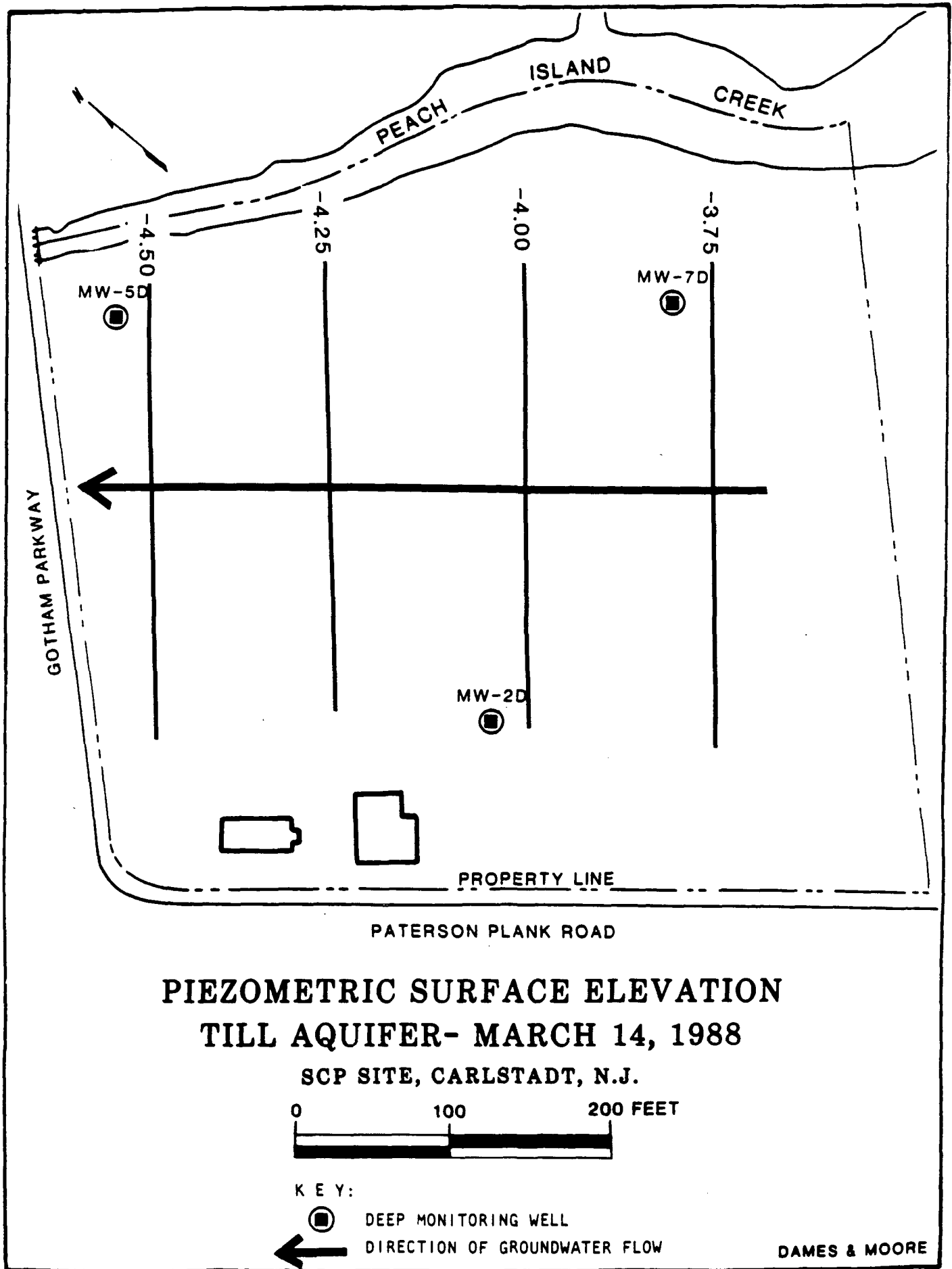


FIGURE 42

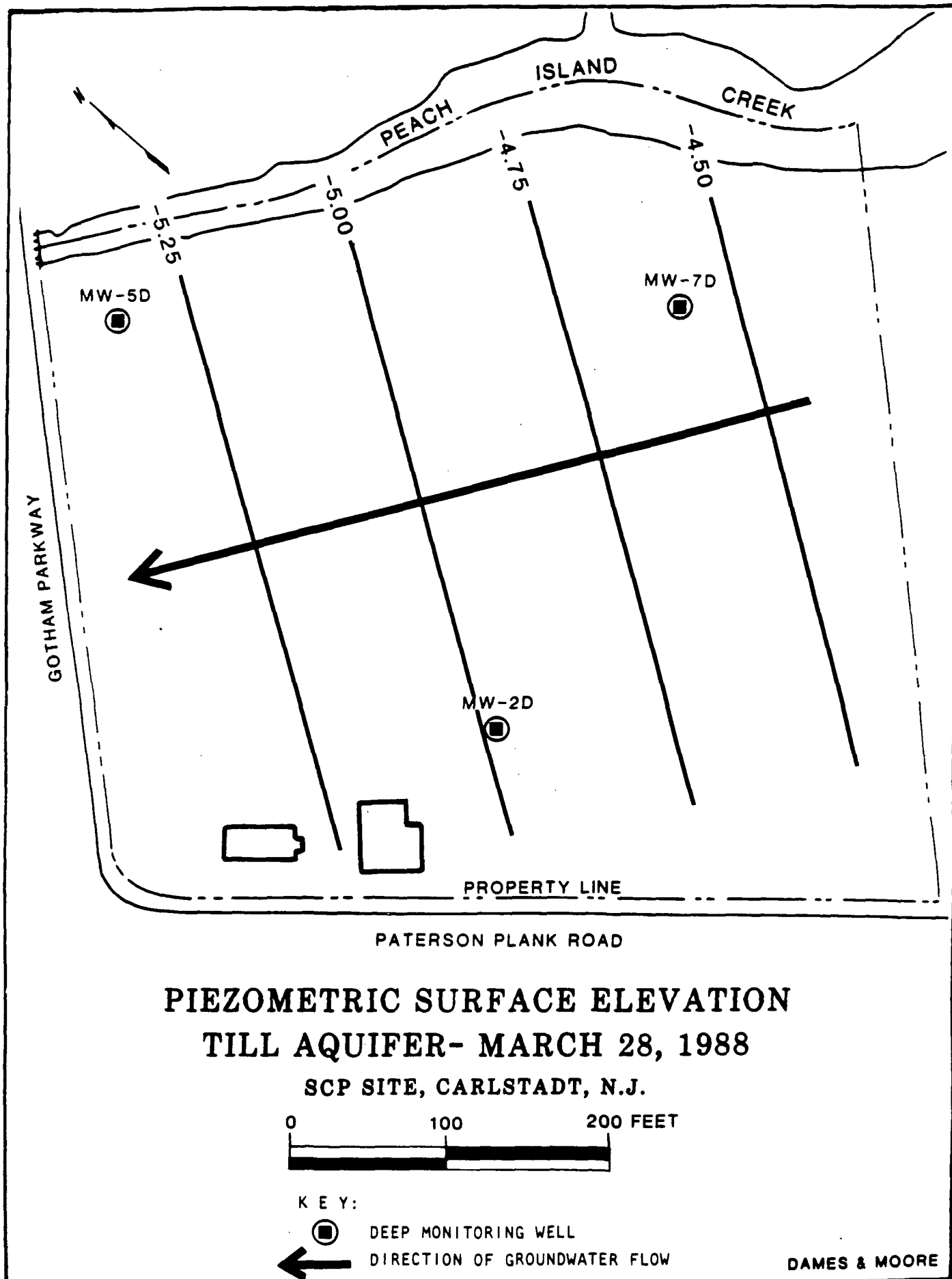


FIGURE 43

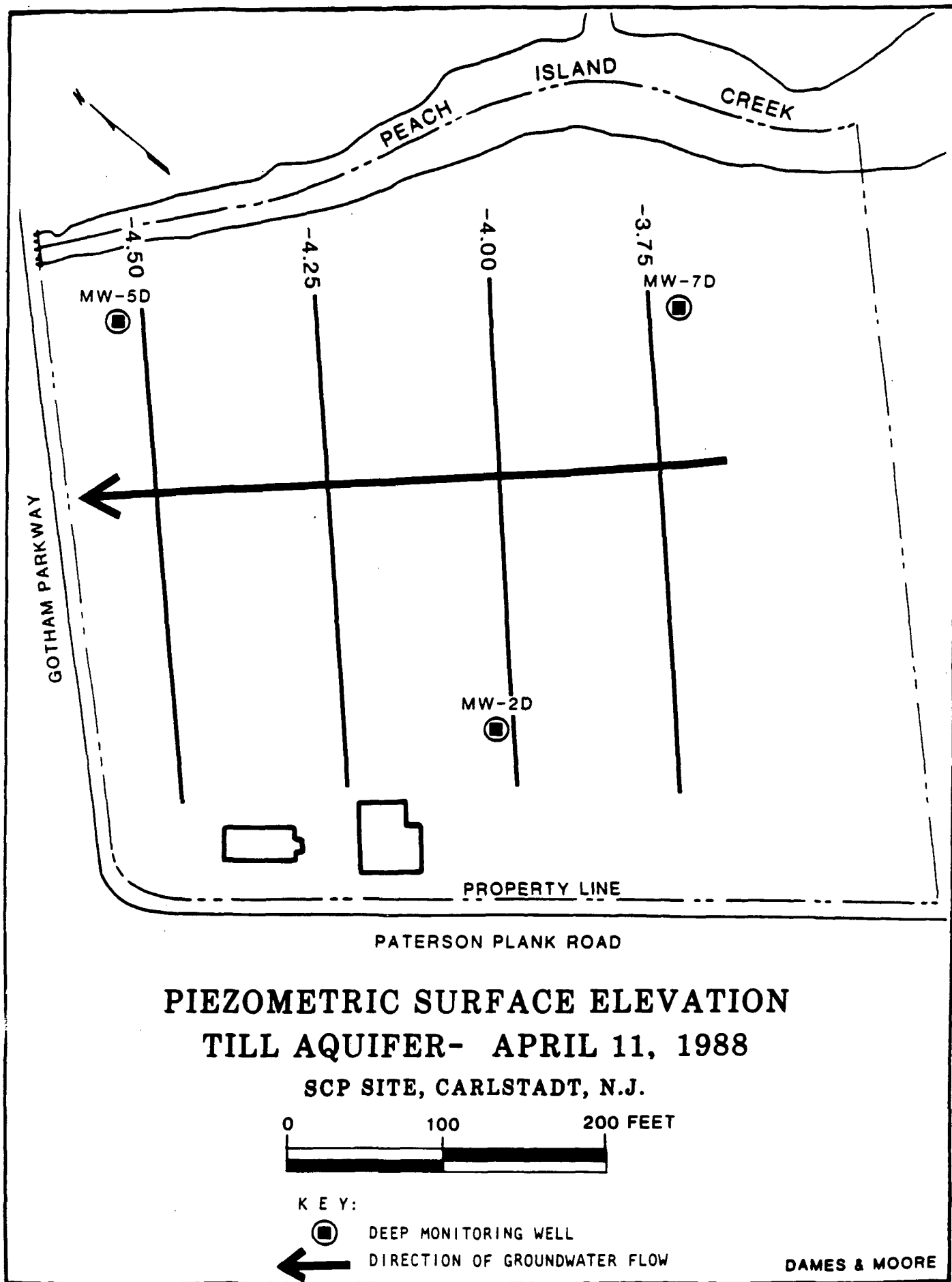


FIGURE 44

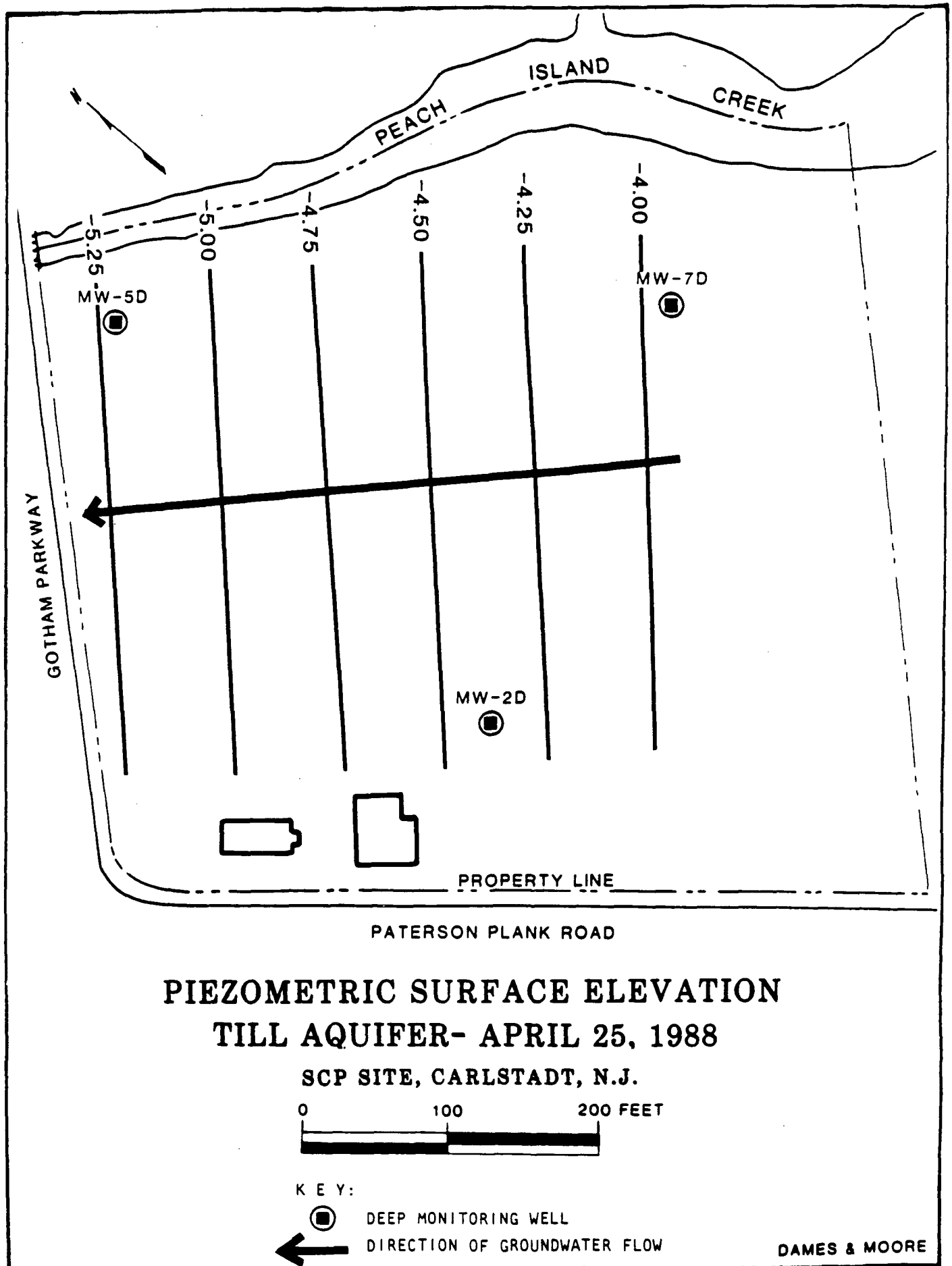


FIGURE 45

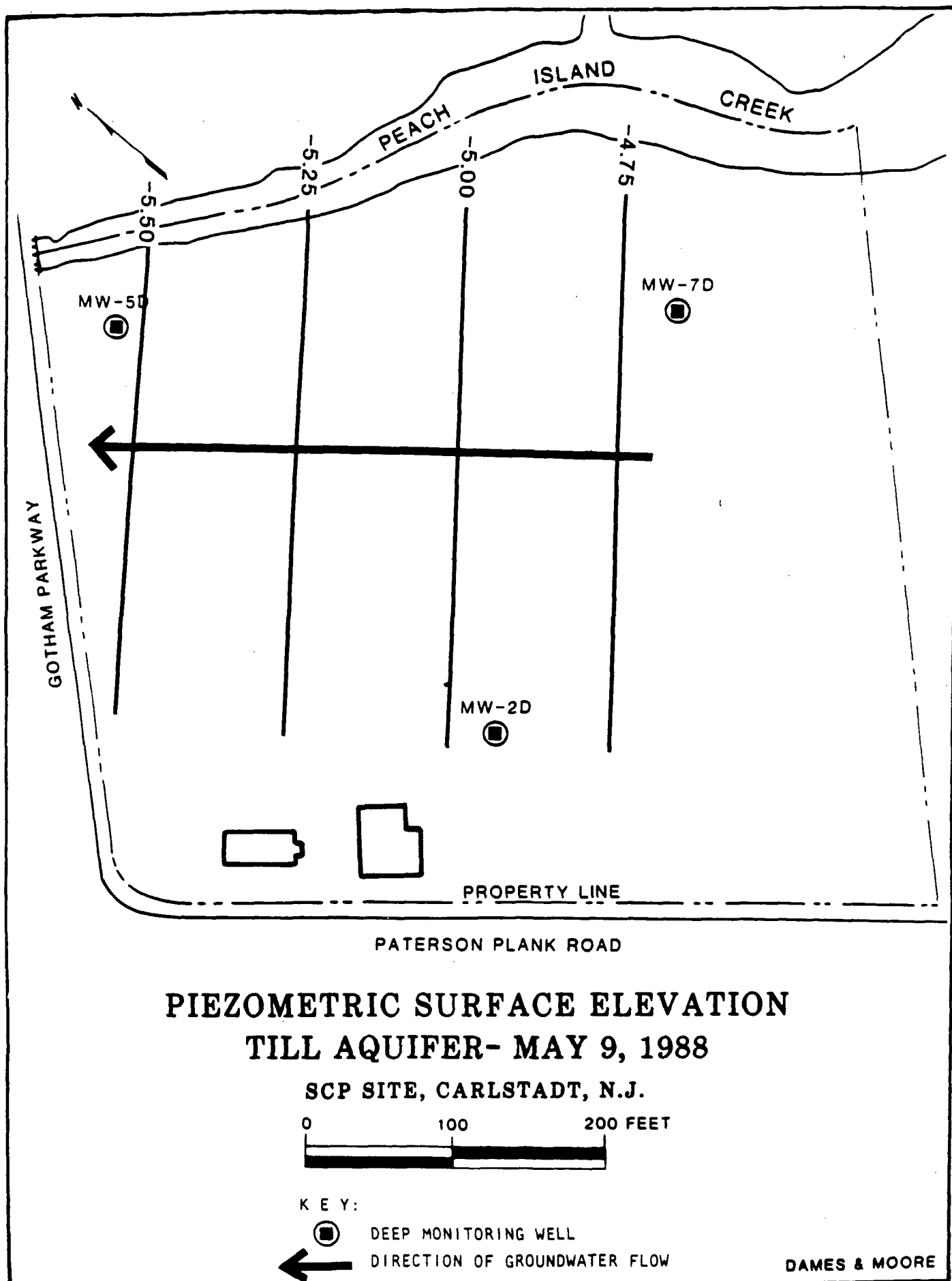
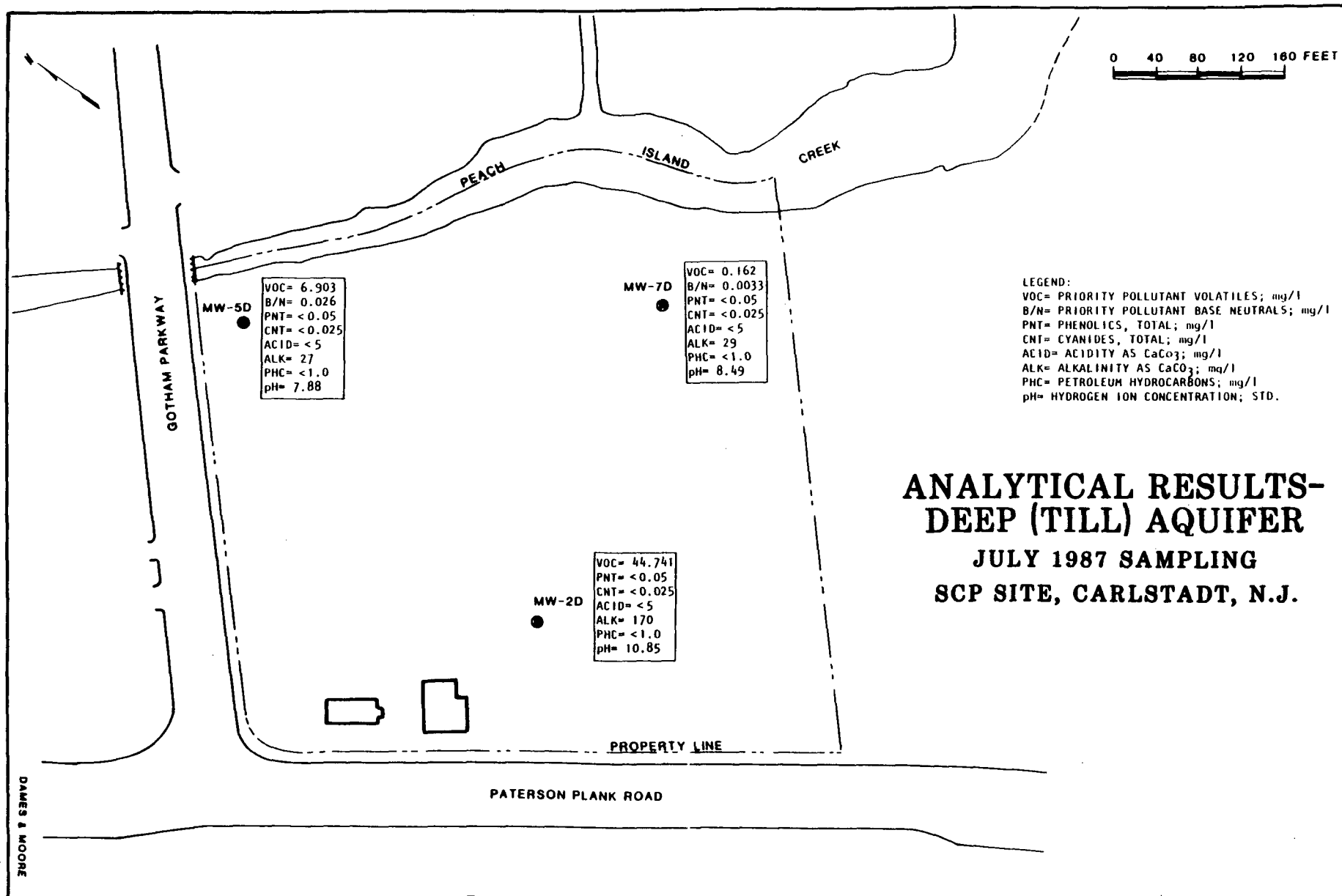


FIGURE 46



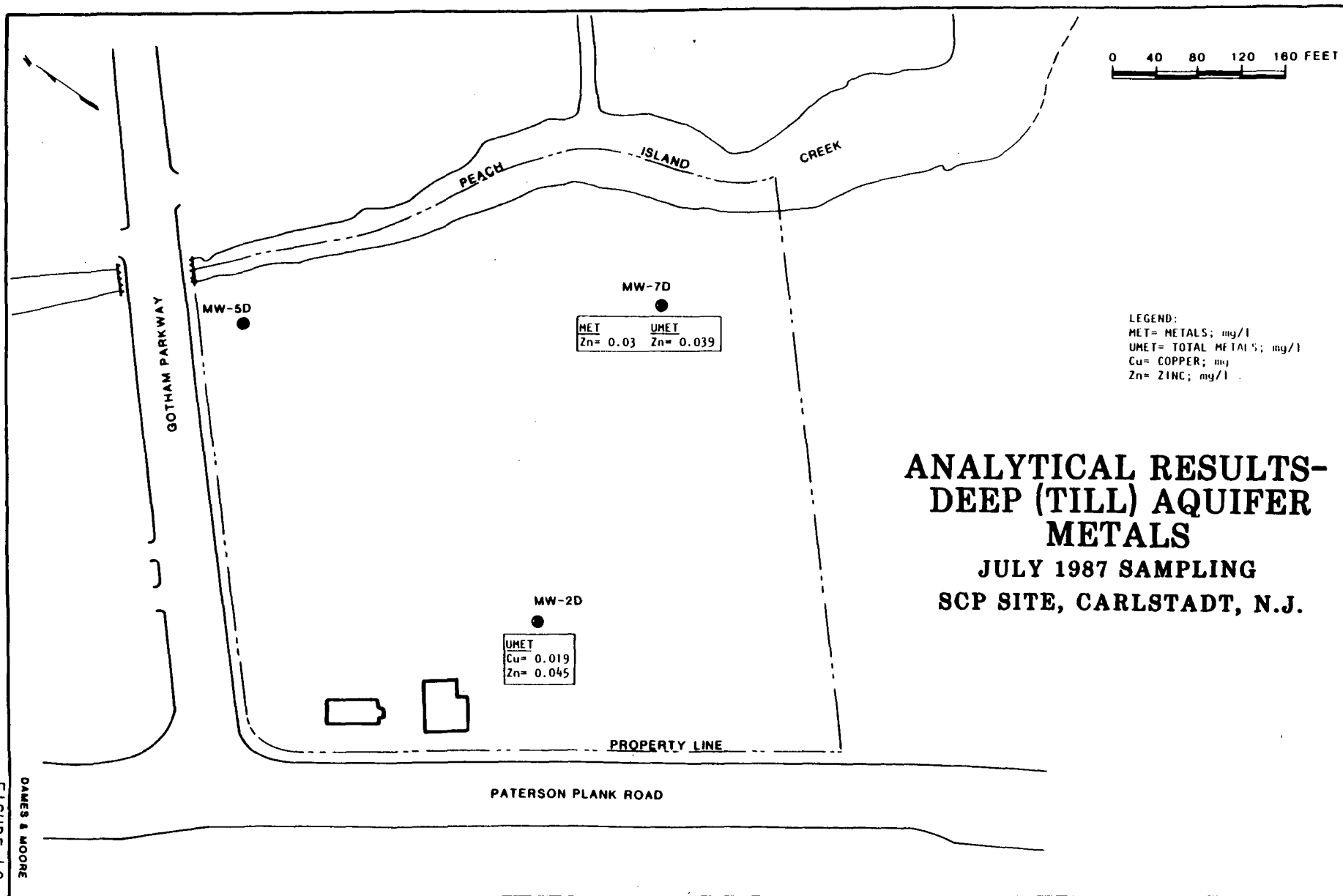
100200

FIGURE 47
DAMES & MOORE

100201

FIGURE 48

DAMES & MOORE



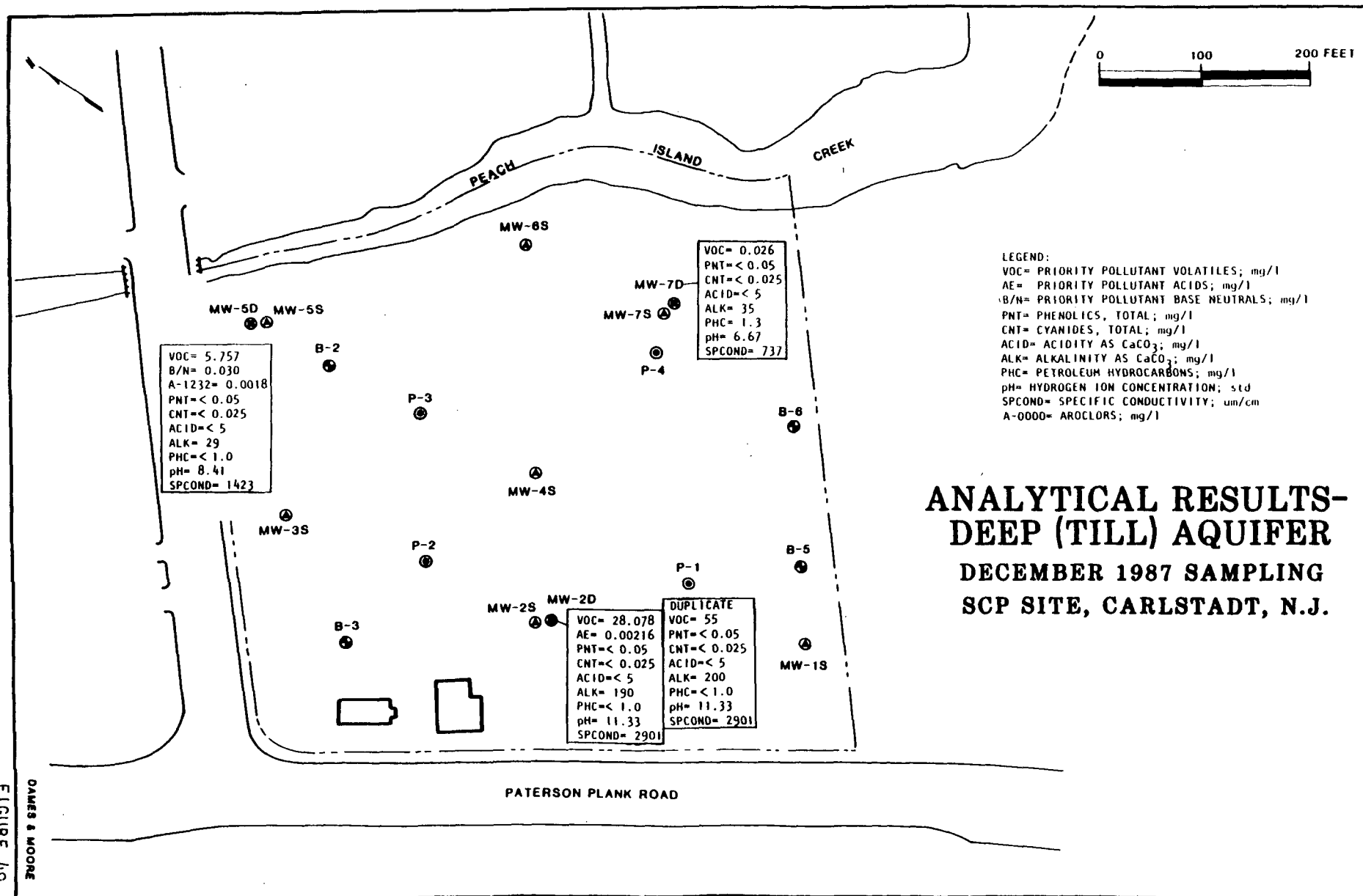
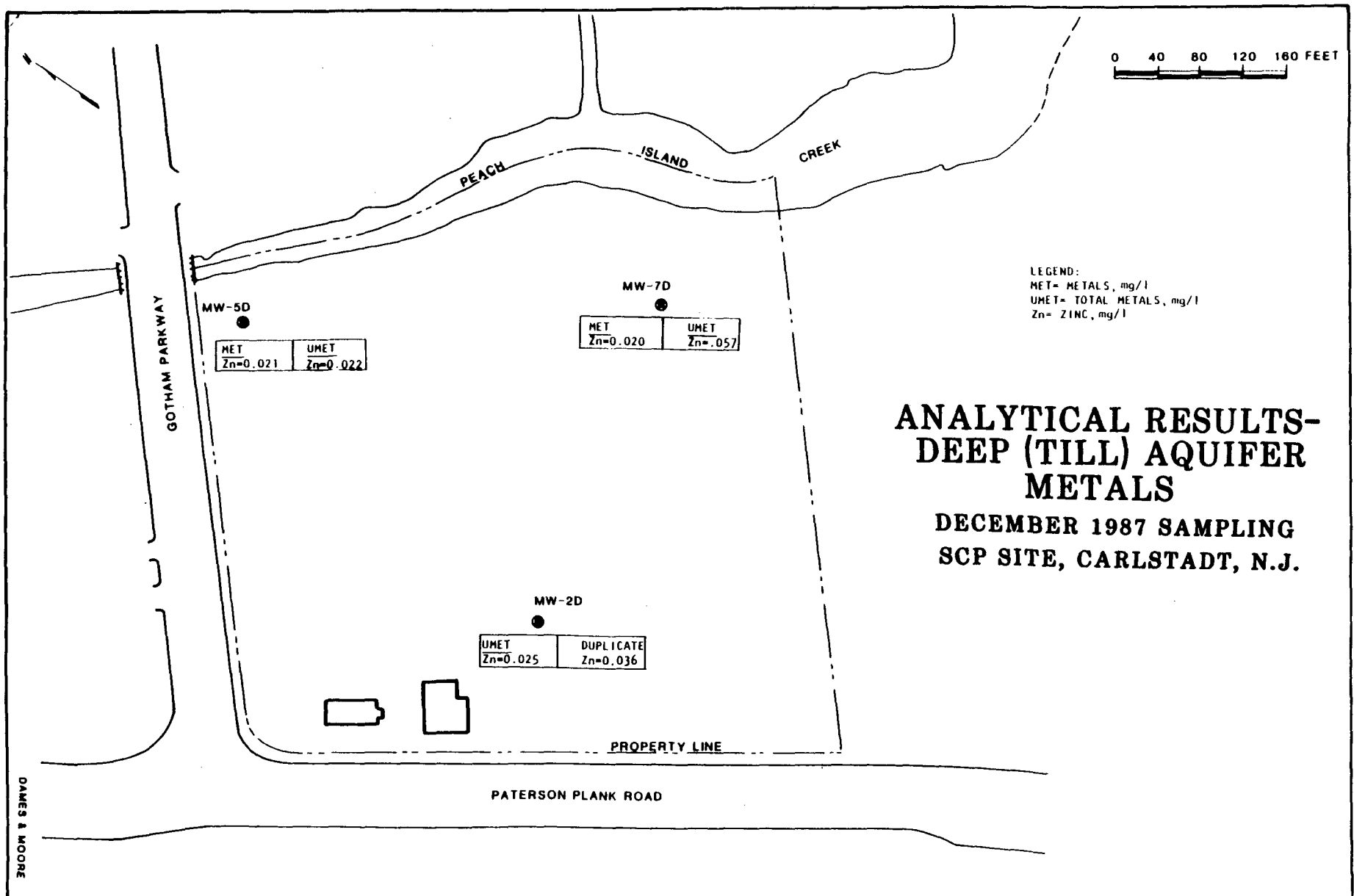
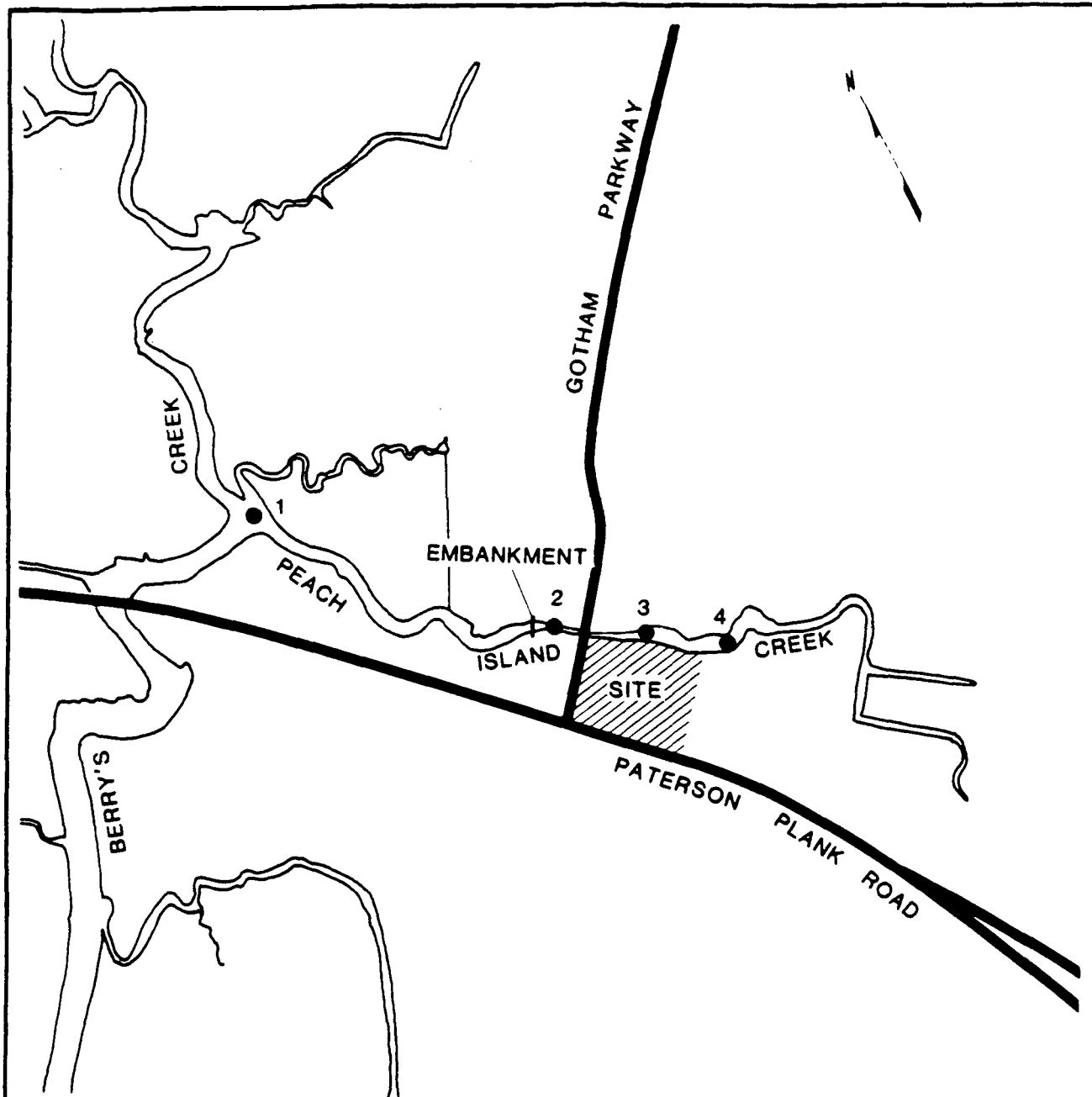


FIGURE 50



DAMES & MOORE



**STREAM WATER AND
SEDIMENT SAMPLING LOCATIONS
SCP CARLSTADT
CARLSTADT, N.J.**

0 500 1000 FEET



KEY:

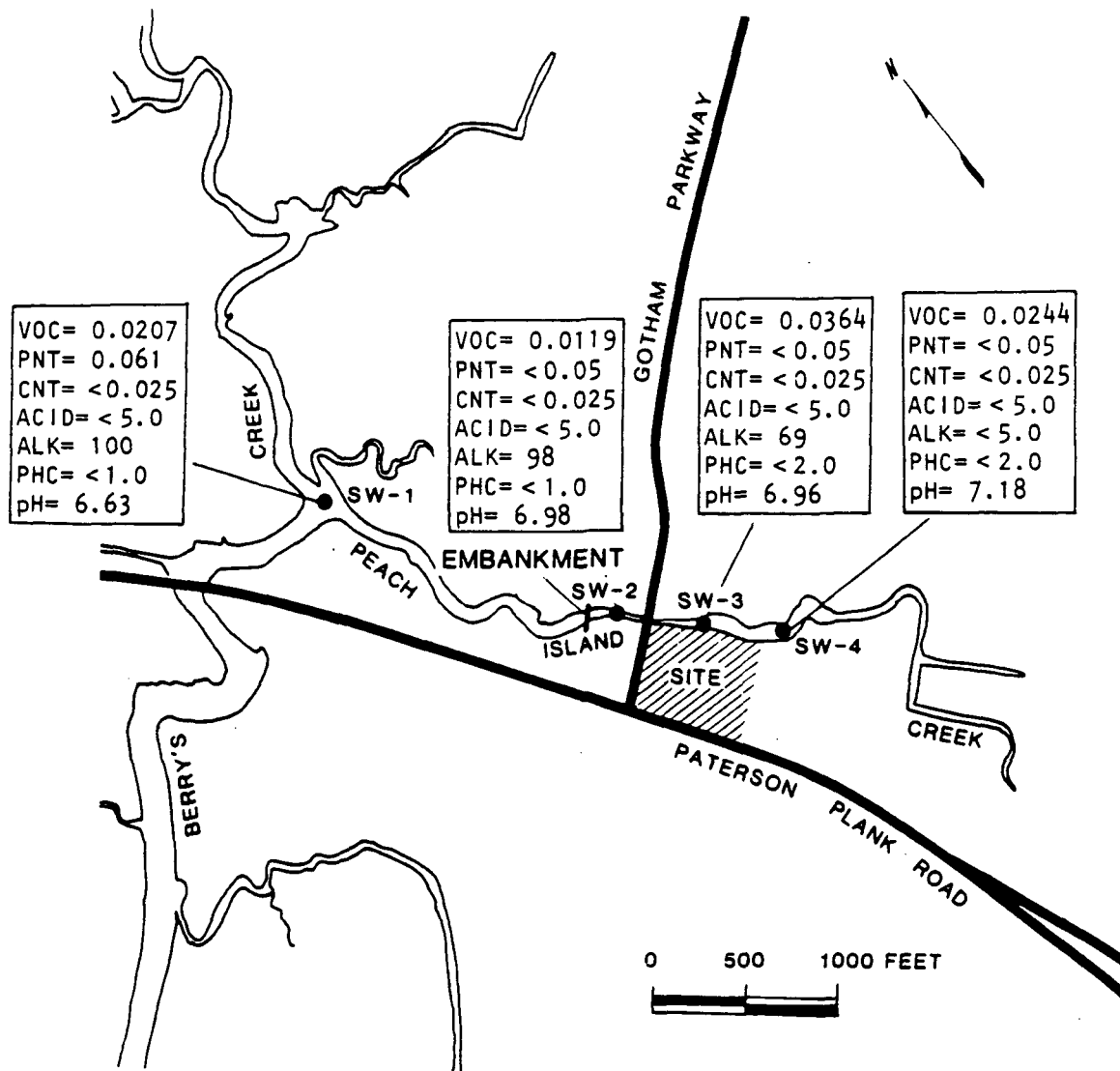
● SAMPLING STATION

BASE FROM AERIAL PHOTOGRAPHY
12/13/78 017-79 2-160

DAMES & MOORE

FIGURE 51

100204



LEGEND:

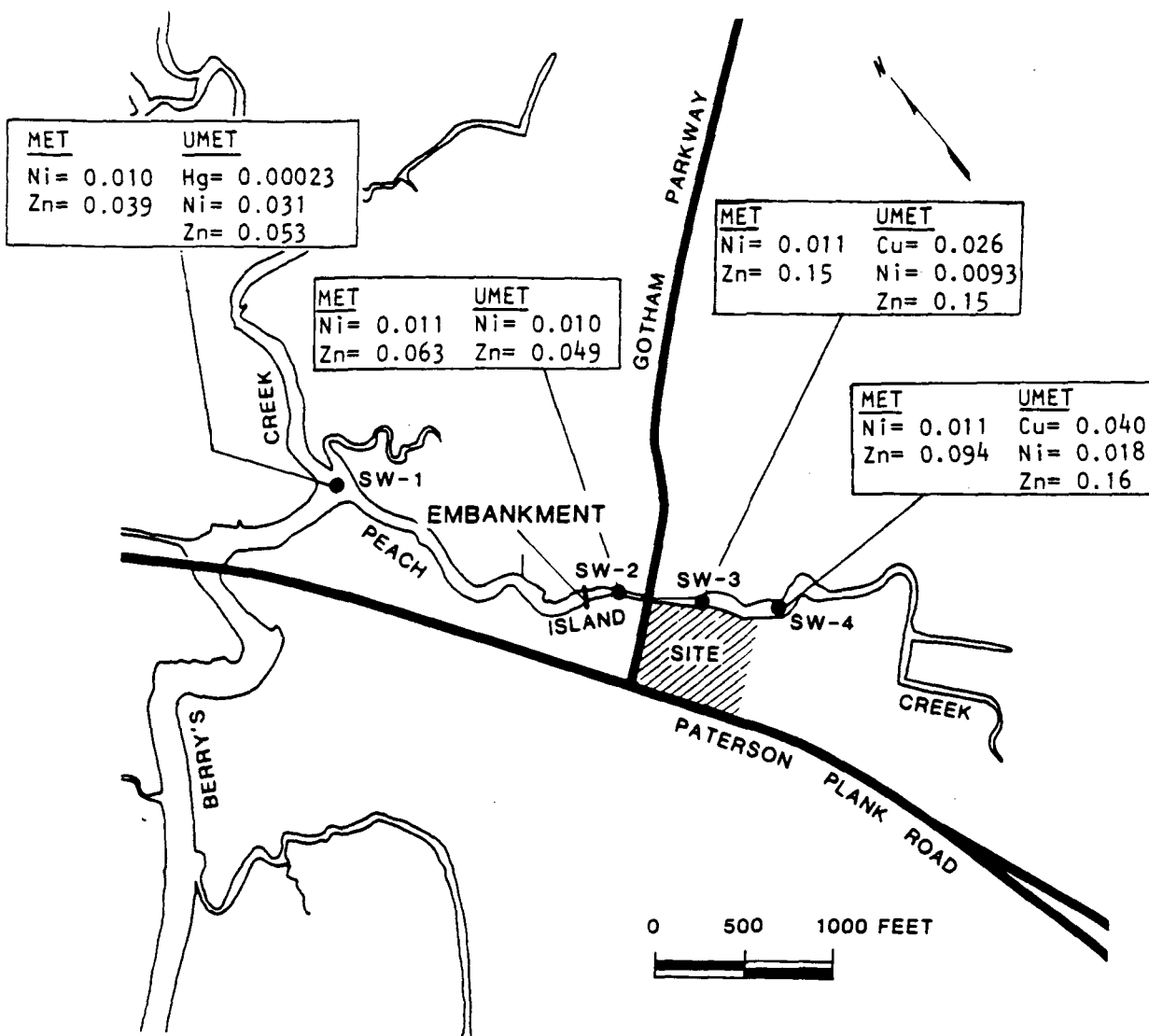
VOC= PRIORITY POLLUTANT VOLATILES; mg/l
 PNT= PHENOLICS, TOTAL; mg/l
 CNT= CYANIDES, TOTAL; mg/l
 ACID= ACIDITY AS CaCO₃; mg/l
 ALK= ALKALINITY AS CaCO₃; mg/l
 PHC= PETROLEUM HYDROCARBONS; mg/l
 pH= HYDROGEN ION CONCENTRATION; std.

ANALYTICAL RESULTS- SURFACE WATER SAMPLES
JULY 1987 SAMPLING
SCP SITE, CARLSTADT, N.J.

DAMES & MOORE

FIGURE 52

100205



LEGEND:

MET= DISSOLVED METALS; mg/l

UMET= TOTAL METALS; mg/l

Cu= COPPER; mg/l

Hg= MERCURY; mg/l

Ni= NICKEL; mg/l

Zn= ZINC; mg/l

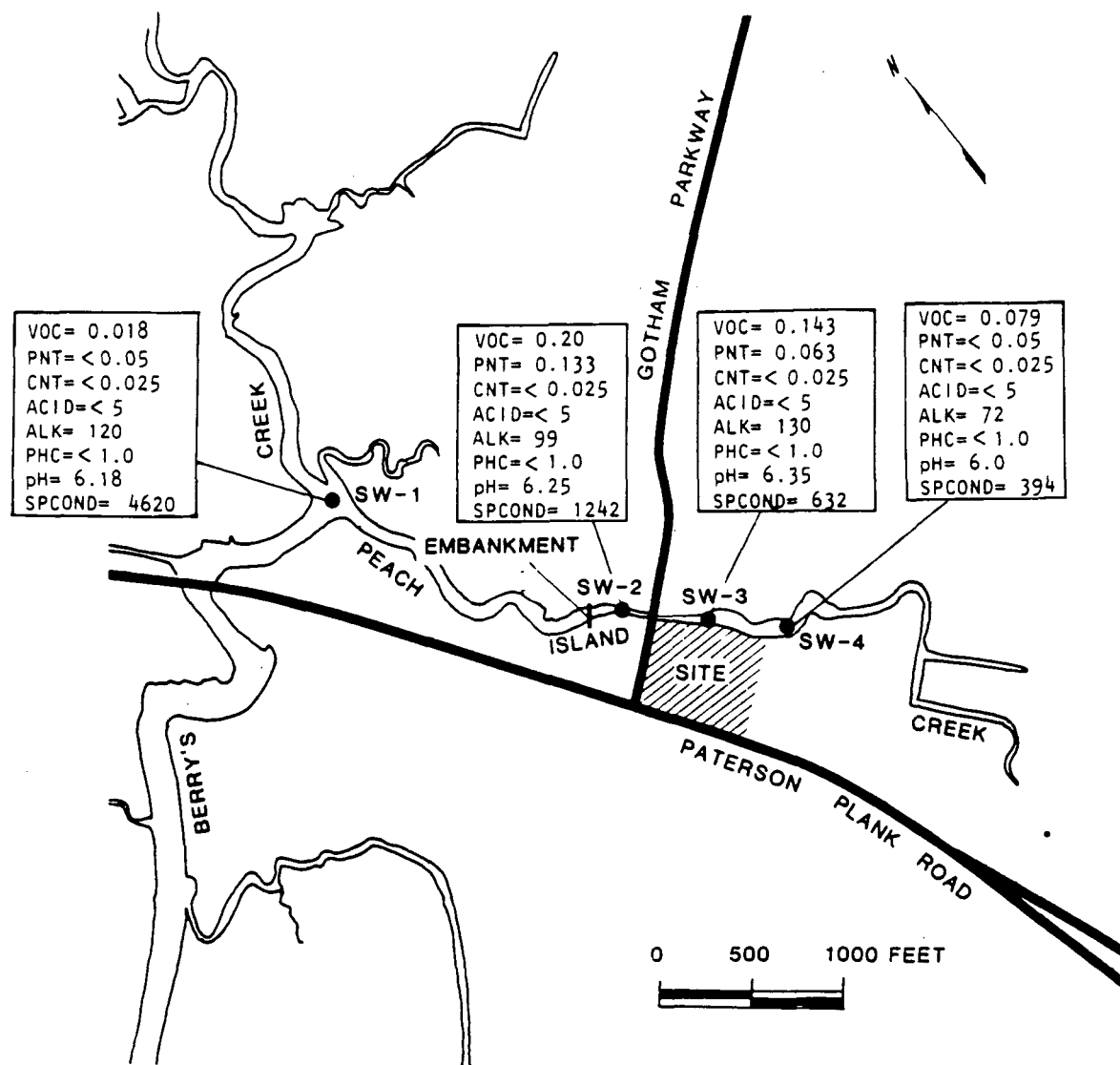
ANALYTICAL RESULTS- SURFACE WATER SAMPLES METALS

**JULY 1987 SAMPLING
SCP SITE, CARLSTADT, N.J.**

DAMES & MOORE

FIGURE 53

100206



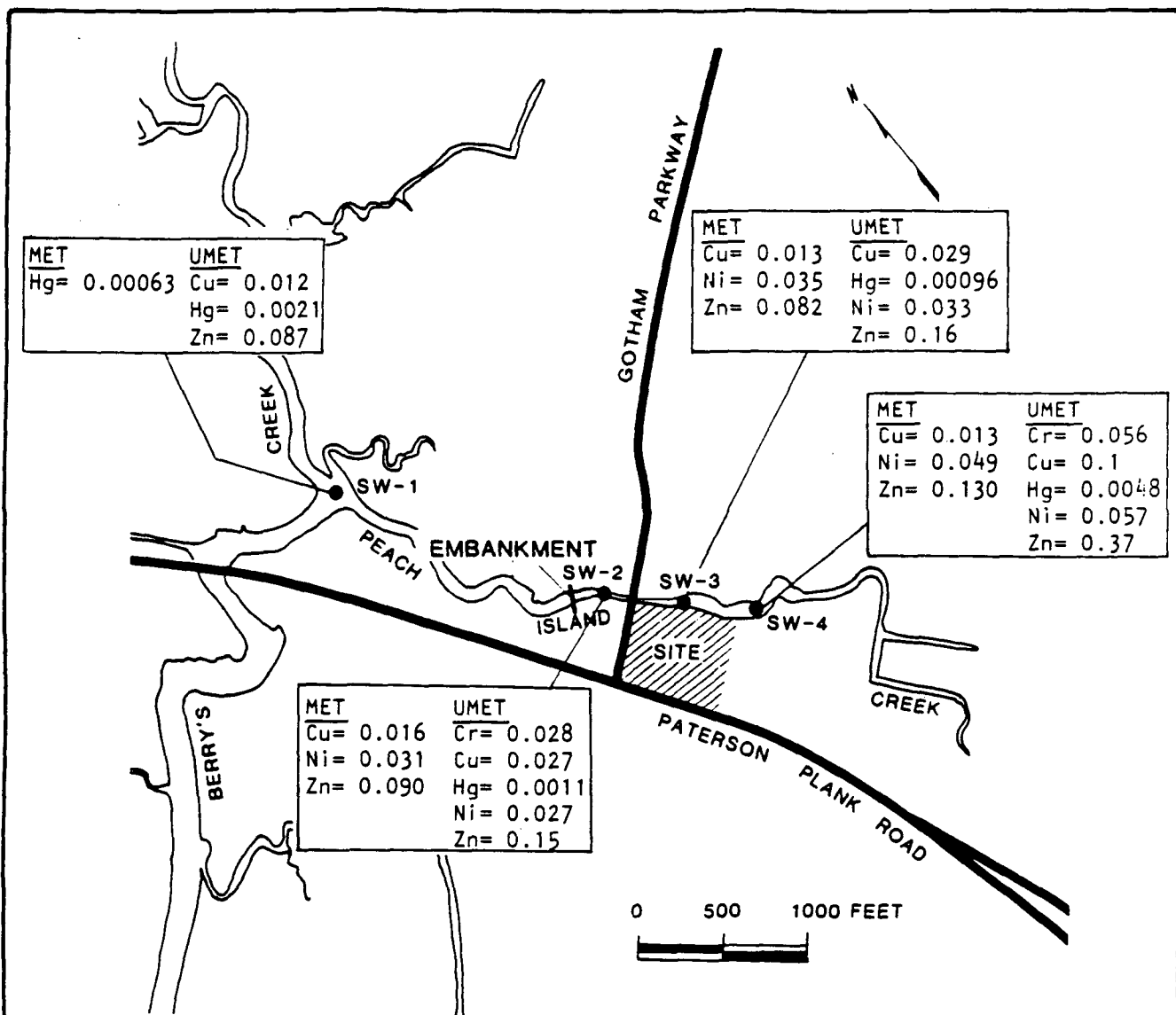
LEGEND:
VOC= PRIORITY POLLUTANT VOLATILES; mg/l
PNT= PHENOLICS, TOTAL; mg/l
CNT= CYANIDES, TOTAL; mg/l
ACID= ACIDITY AS CaCO_3 ; mg/l
ALK= ALKALINITY AS CaCO_3 ; mg/l
PHC= PETROLEUM HYDROCARBONS; mg/l
pH= HYDROGEN ION CONCENTRATION; std.
SPCOND=SPECIFIC CONDUCTIVITY, $\mu\text{m/cm}$

ANALYTICAL RESULTS- SURFACE WATER SAMPLES DECEMBER 1987 SAMPLING SCP SITE, CARLSTADT, N.J.

DAMES & MOORE

FIGURE 54

100207



LEGEND:

MET= DISSOLVED METALS; mg/l

UMET= TOTAL METALS; mg/l

Cr= CHROMIUM; mg/l

Cu= COPPER, mg/l

Hg= MERCURY, mg/l

Ni= NICKEL, mg/l

Zn= ZINC, mg/l

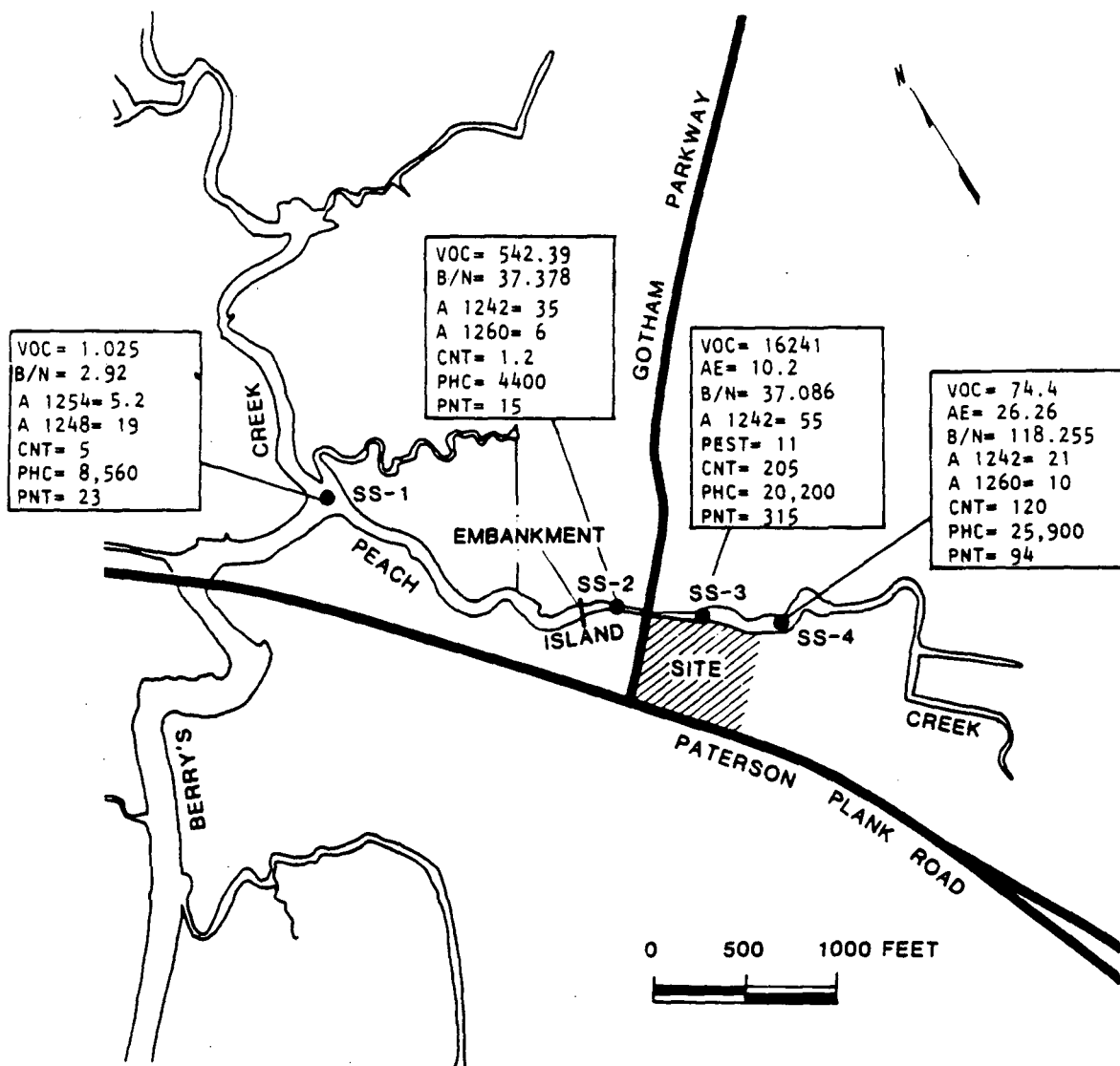
ANALYTICAL RESULTS- SURFACE WATER SAMPLES METALS

**DECEMBER 1987 SAMPLING
SCP SITE, CARLSTADT, N.J.**

DAMES & MOORE

FIGURE 55

100208



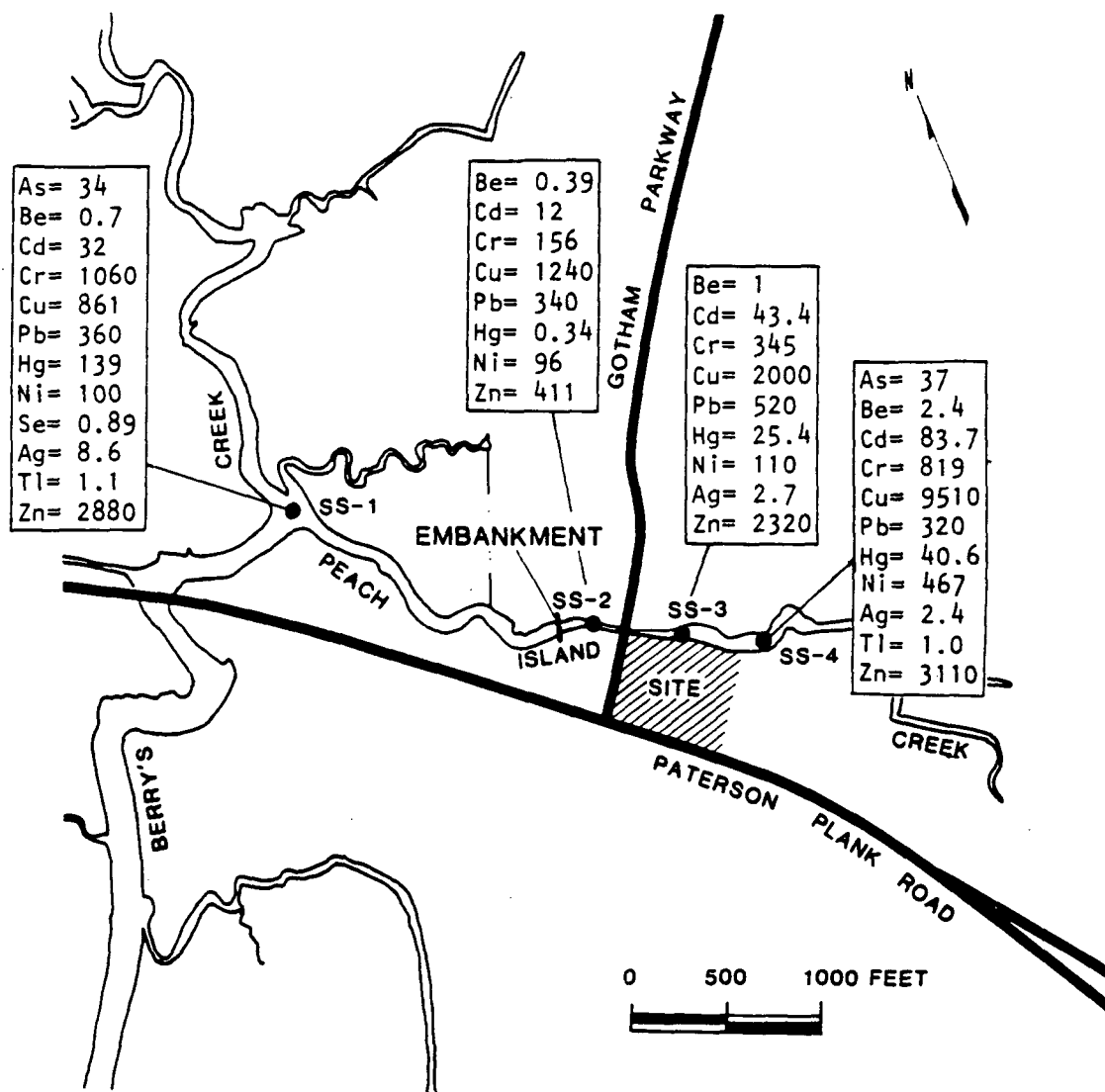
LEGEND:

VOC = PRIORITY POLLUTANT VOLATILES, mg/kg
AE = PRIORITY POLLUTANT ACIDS, mg/kg
B/N = PRIORITY POLLUTANT BASE NEUTRALS, mg/kg
CNT = CYANIDES, TOTAL; mg/kg
PHC = PETROLEUM HYDROCARBONS; mg/kg
PNT = PHENOLICS, TOTAL; mg/kg
PEST = PESTICIDES, TOTAL; mg/kg
A 0000 = AROCLORS; mg/kg

**ANALYTICAL RESULTS- SEDIMENT SAMPLES
AT 0 TO 6 INCHES
DECEMBER 1987 SAMPLING
SCP SITE, CARLSTADT, N.J.**

DAMES & MOORE

FIGURE 56



ANALYTICAL RESULTS- SEDIMENT SAMPLES

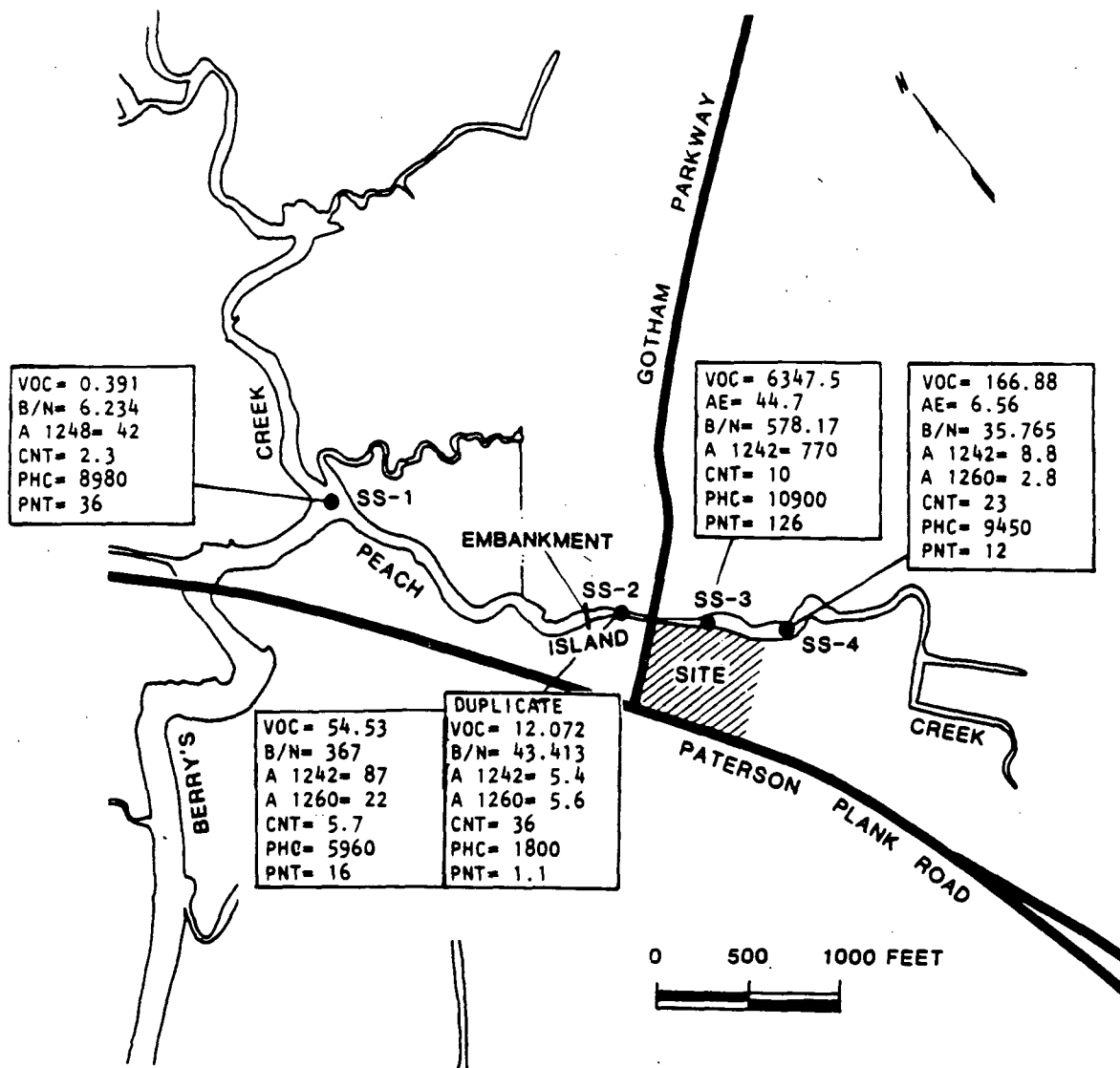
METALS AT 0 TO 6 INCHES

SCP SITE, CARLSTADT, N.J.

DAMES & MOORE

FIGURE 57

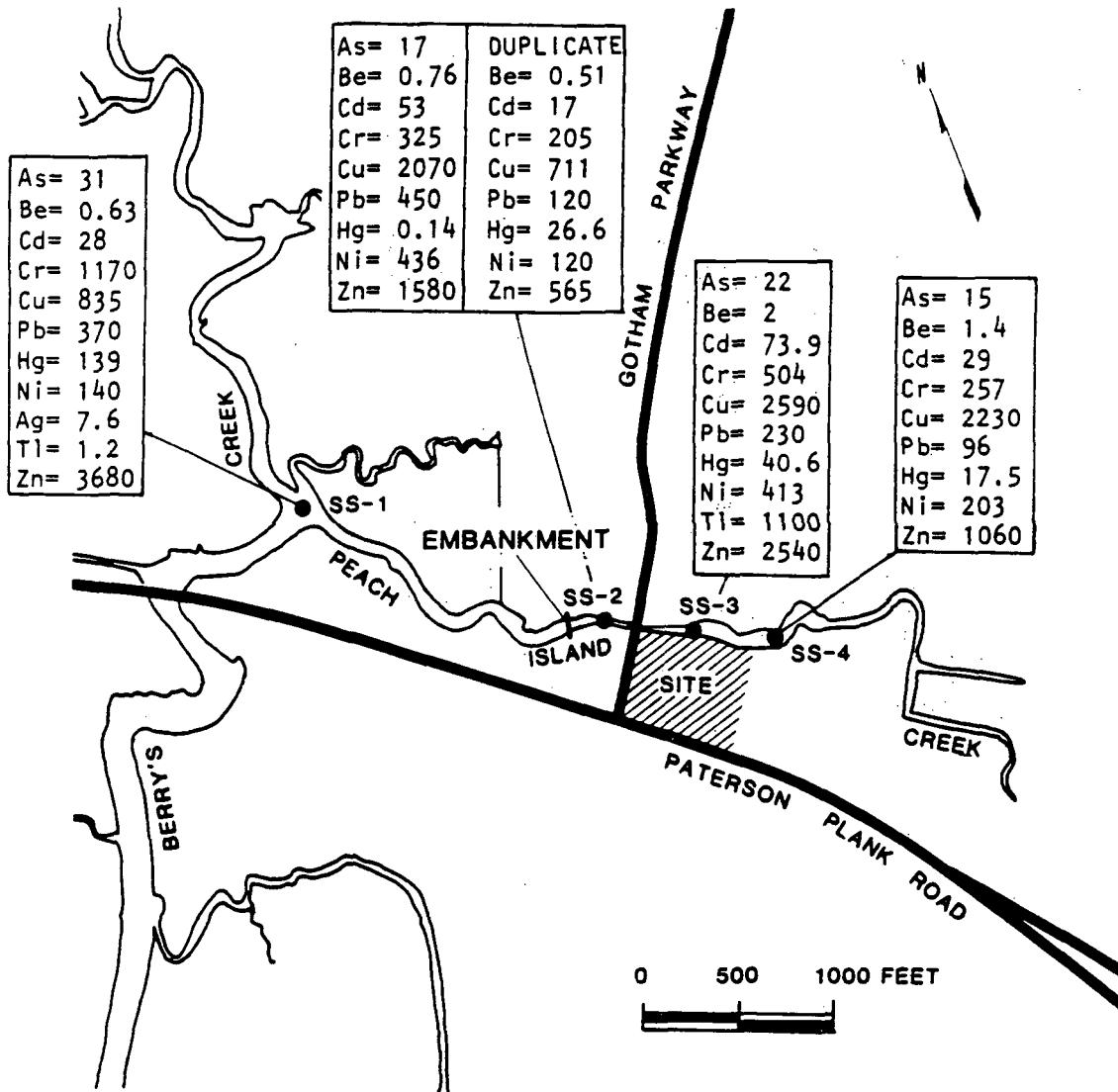
100210



**ANALYTICAL RESULTS- SEDIMENT SAMPLES
 AT 12 TO 18 INCHES
 DECEMBER 1987 SAMPLING
 SCP SITE, CARLSTADT, N.J.**

DAMES & MOORE

FIGURE 58



ANALYTICAL RESULTS- SEDIMENT SAMPLES METALS AT 12 TO 18 INCHES

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FIGURE 59

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